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DECEMBER
1937

factory

Management and Maintenance

The Folly of Wage Regulation

Same Power, New Drives, Doubled Output

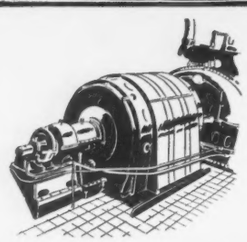
Only a 30-Man Plant—But It's Mass Production

McGRAW-HILL PUBLISHING COMPANY, INC.

134.371

"Where's all your stock of lubes?"

"*That's all we need since they made that* LUBRICATION SURVEY!"



ONE WAY TO CUT OIL STOCK—STANDARDIZE ON STANOILS

Stanoils offer the first opportunity to simplify lubrication and lubricant stocks through standardization. Seven grades of Stanoil can replace twenty-seven other oils.

There are six outstanding qualities that assure better results wherever Stanoils are used. Unusually high stability and low carbon forming tendencies mean longer useful life. Good viscosity index assures better lubrication over a wide range of applications. Good demulsibility, excellent color and low pour point are found in each grade.

Stanoils will not only handle a greater variety of conditions but will do a *better* lubricating job than the oils they replace.

Copr. 1937, Standard Oil Co.

A THOROUGH, scientific examination of your lubrication requirements by a Standard Lubrication Engineer will show *many* ways in which you can save money, particularly on your stock of lubricants.

Complicated lubricant stocks are hard to handle and dispense, and confusing to stock clerks and oilers alike. As a result of this confusion, lubrication recommendations are frequently ignored, definitely contributing to higher maintenance and lubricating costs.

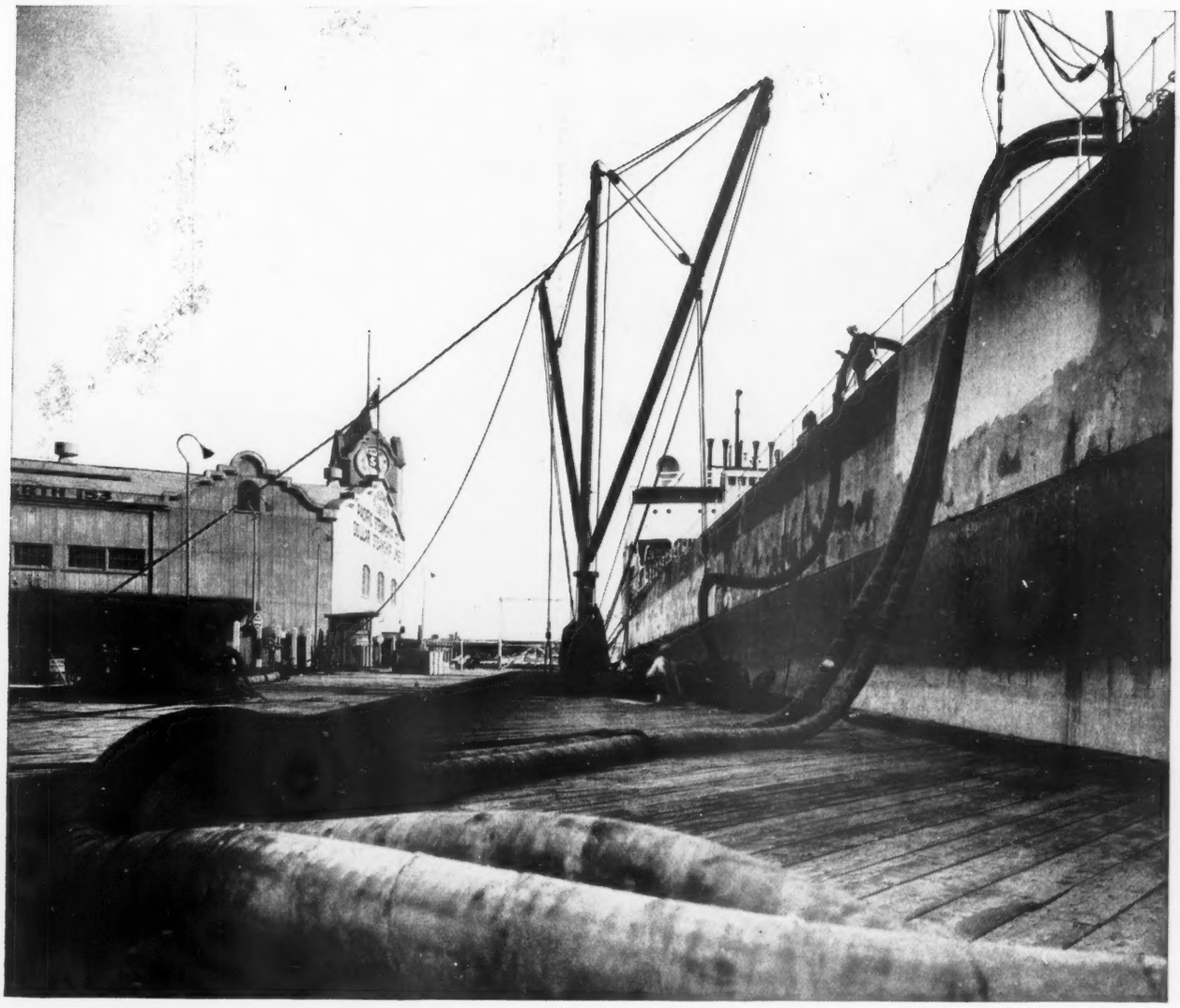
A lubrication survey in your plant may show many instances in which one lubricant can replace three or four brands now carried. The saving this means is evident: reduced stock, less waste, less handling and lubricating time, and above all, full assurance of the right lubricant for every job.

Call the Lubrication Engineer at your local Standard Oil (Indiana) office. Let him tell you *how* a lubrication survey can bring about further cost reduction in your own plant. There's no obligation. Make an appointment with him today.

THE RIGHT LUBRICANT • PROPERLY APPLIED • TO REDUCE COSTS

STANDARD OIL COMPANY (INDIANA)

LUBRICATION ENGINEERING



MORE GASOLINE IN TEN MINUTES THAN YOU WILL USE IN 30 YEARS

A typical example of Goodrich improvement in rubber

IN THE next 30 years you will probably use 36,000 gallons of gasoline. Sounds like a lot, doesn't it? Yet every one of the above lengths of Goodrich hose handles more than that, from shore tanks to tankers, in ten minutes.

Cheapest way to transport gasoline or oil is by water. But loading and unloading big tankers was an expensive problem.

Then Goodrich developed a special hose for the purpose, capable of standing such terrific pressure or suction that one length of hose can fill or empty a 3,500,000-gallon tanker in less than a day.

Pressure to force such a volume of oil from shore tanks across docks, up ship side and across decks often pulsates so that the hose whips and thrashes like a mammoth serpent. But Goodrich engineers designed their hose to withstand that abrasion, resist pressure that would burst ordinary types of hose, resist the attack of oil which ruins most rubber, and withstand pressure from the outside when suction is applied to unload the tanker at destination.

Here was a product presenting not one problem but many, all solved by the same Goodrich engineers who are constantly at work to improve hose, belting and every Goodrich product. These engineers have been responsible for many of the most far-reaching improvements in rubber—improvements which have increased its age, flexibility, and resistance to abrasion, chemicals, heat. When you specify Goodrich to your mechanical rubber goods distributor you automatically get all the benefit of these improvements, no matter how small or large your order, no matter how standard or special the product you buy. The B. F. Goodrich Company, Mechanical Rubber Goods Division, Akron, Ohio.

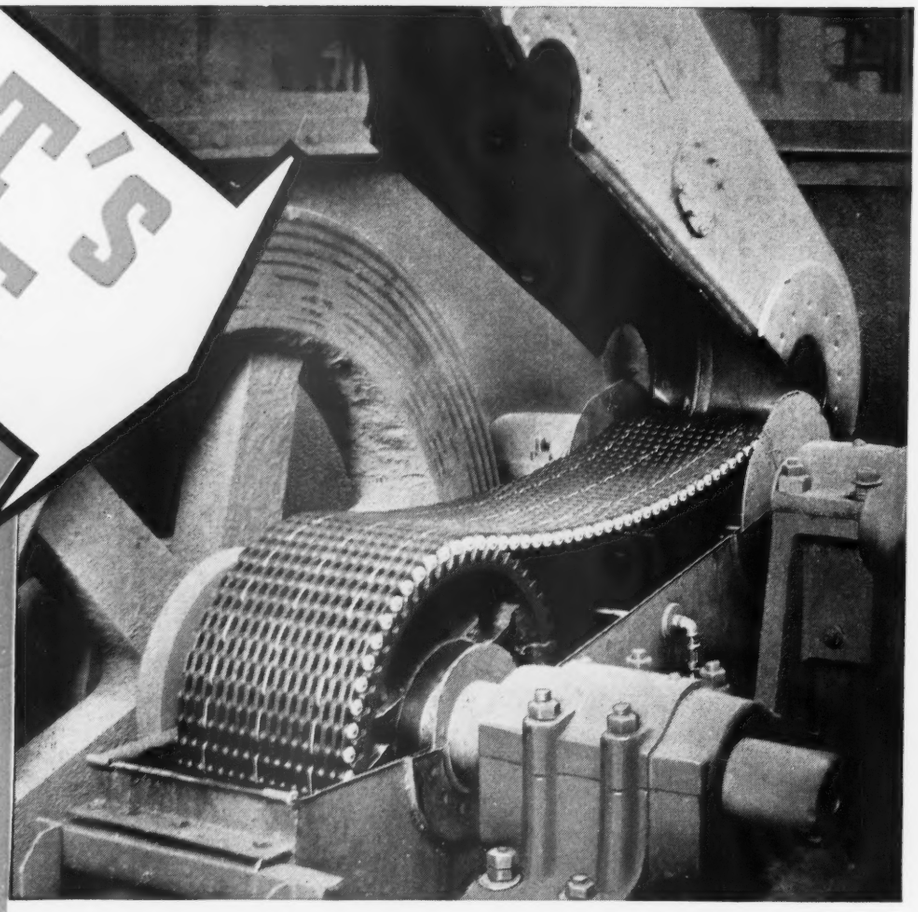
Goodrich

ALL *products problems* IN RUBBER

Another story of Goodrich development work appears on the page facing the third cover

IT'S TRUE

Even in FIRST COST SILENT CHAIN DRIVES ARE OFTEN *Lower than Belts*



● Some plant executives have the idea that silent chain drives are expensive. Actually they cost less... even their first cost being lower than belts in many instances. Over a period of years, Link-Belt Silverstreak Silent Chain Drives always show important savings because they are built to give constantly efficient service with practically no attention or upkeep expense. They transmit full speed and power... never slip . . . save space . . . and are smooth and quiet in operation. Cut your production costs . . . save maintenance trouble and expense by equipping your machines with Silverstreak Silent Chain Drives.

Send for data book No. 125. Also send for catalogs covering roller chain drives, speed reducers, variable speed transmissions, and the complete line of transmission units such as anti-friction and babbitted bearing pillow blocks, clutches, couplings, take-ups, pulleys, gears, etc.

Link-Belt Company, Indianapolis, Chicago, Philadelphia, Atlanta, San Francisco, Toronto, or any of our offices located in principal cities. 7159

Send for this 96-page engineering data book No. 125.

LINK-BELT
Silverstreak
SILENT CHAIN DRIVES

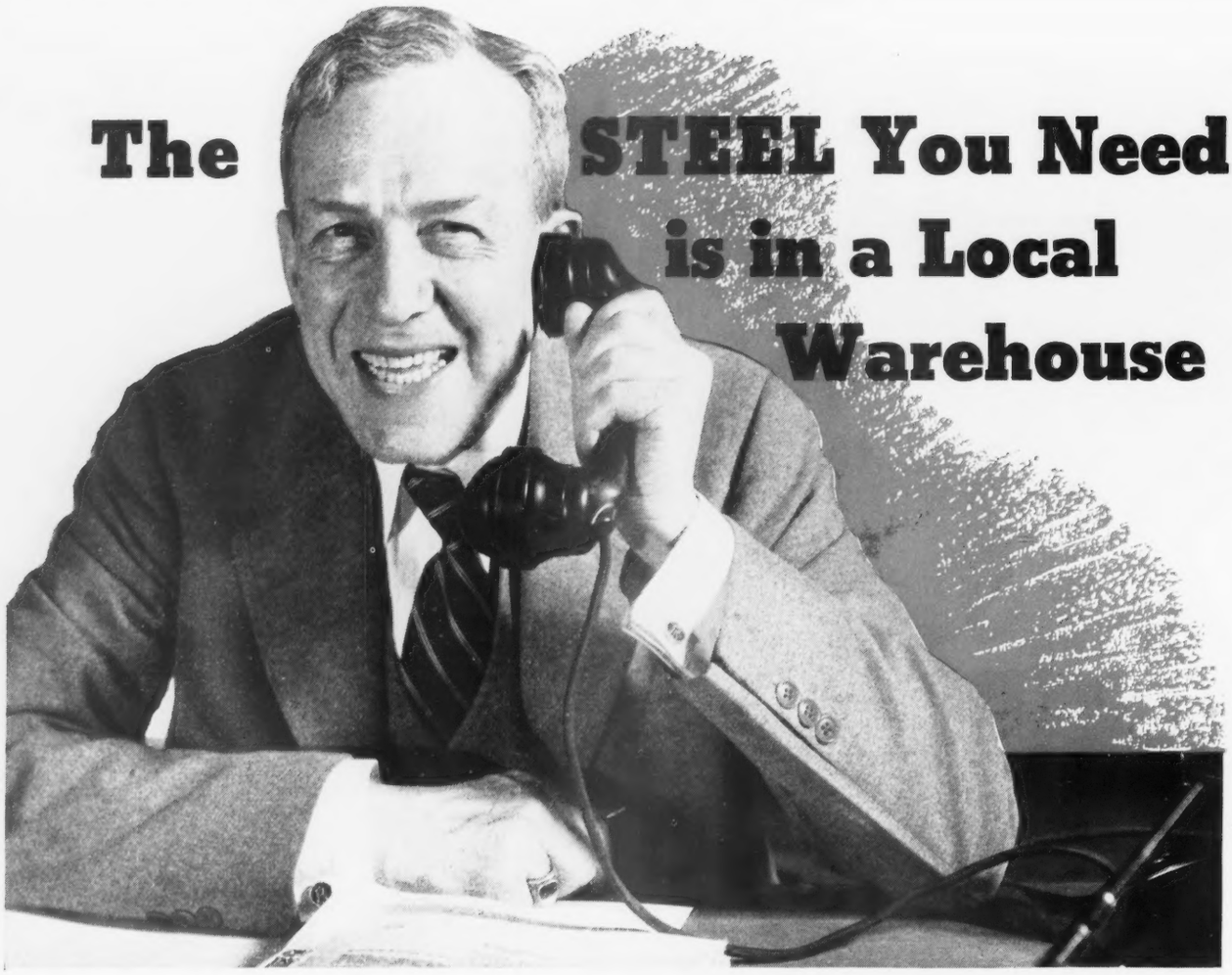
SECURITY with HYATT *Roller Bearings*

19 Hyatt Roller Bearings are used in this 10 Ton Heavy Duty Monorail Hoist, built by **NORTHERN ENGINEERING WORKS, DETROIT, MICHIGAN.**

Hyatt Roller Bearings are built into material handling equipment with the utmost security because they protect vital working parts against shocks, wear and misalignment. Years of successful experience have proved that these dependable bearings help extend life and assure smoother, quieter, and more efficient operation with less care.

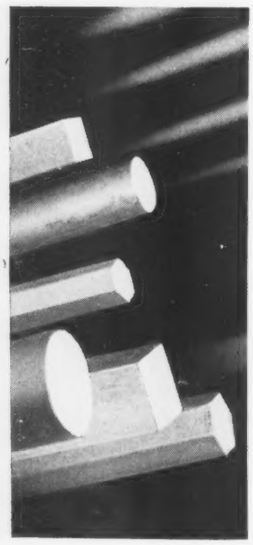
Thus is Hyatt protection — the result of correct bearing design, precision manufacture and sound application, by Hyatt engineers and craftsmen — generously contributing to greater production. Is there any way we may serve you? Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey.

The STEEL You Need is in a Local Warehouse



● The bulk of your cold drawn steel requirements is in a local Union Drawn Distributor's warehouse.

These distributors are steel service stations—located in busy industrial sections where Union Cold Drawn Bars are in hourly demand.



They carry large stocks ready to fill your needs quickly. When you want bars, just tell them what kind and how many. It is a matter of minutes to get your order ready and put it in transit.

This type of steel service will save you money.

Union Cold Drawn Steels

MARK THESE ITEMS "MUST!"

for new construction... modernization... maintenance...

1. *Better lighting*

... Increases production per man. Reduces waste. Check complete Graybar line of fixtures... glassware.

2. *Motors and control*

...Recent improvements have been made in motor design. For the *one* right motor for the job... Graybar.

3. *Modern wiring*

... Up-to-date wiring layouts speed up production. Dependable equipment lowers maintenance costs.

4. *Unit heaters · fans*

...Good ventilation pays in increased production. Graybar suggests simple improvements with unit heaters... fans.

5. *Signaling.. Inter-Phones*

... Investigate these time-savers. Graybar offers a full line of signals, Inter-Phones, sound systems.

6. *Electrical tools*

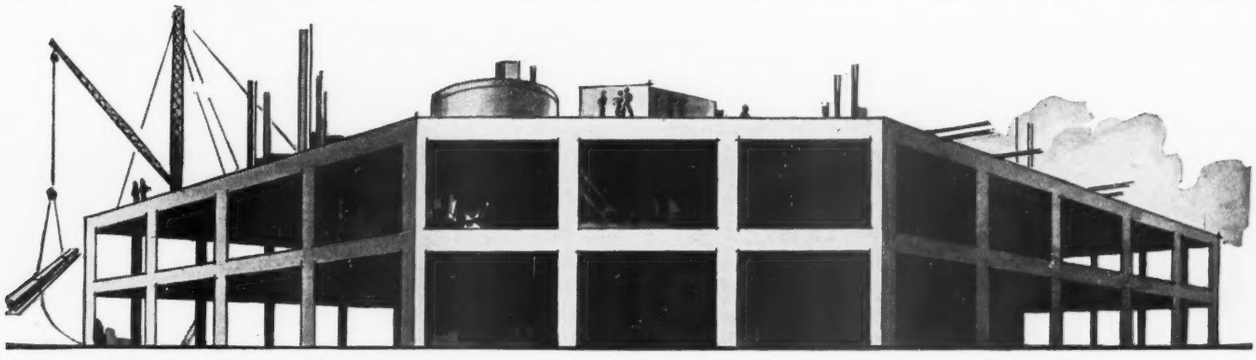
...Good tools... good workmen! Graybar is the logical source for all kinds of electrical tools and other supplies.

One source for Everything Electrical

Distributed and guaranteed by GraybaR ELECTRIC COMPANY

GraybaR

OFFICES IN 83 PRINCIPAL CITIES EXECUTIVE OFFICES: GRAYBAR BUILDING, NEW YORK, N. Y.



MILLIONS FOR DEFENSE

THIS is the U. S. Rubber steam hose testing rack. Like a battery of anti-aircraft guns, its purpose is defensive. Subjecting U. S. Matchless Burst-Proof Steam Hose to destructive blasts of superheated steam, it mercilessly reveals possible performance failure—in advance of production and sale!

Champion of economy, efficiency, and lowered operating costs, this warlike instrument is more than an ingenious laboratory device. It is the symbol of U. S. Rubber's unremitting war against inefficiency—its millions of research dollars and millions of factory man-hours *freely spent in defense* of the purchaser's investment. It symbolizes what we mean when we say that U. S. Rubber Mechanical Goods have built into them—

SERVICE BEYOND PRICE AND SPECIFICATIONS

The new 1937 U. S. Hose Catalog contains 48 pages packed full of illustrations and data. All new hose items are shown. Also it includes section devoted to couplings.

United States Rubber Company

United States Rubber Products, Inc., New York, N. Y.

(Reading time: 27 seconds or less)

● Indifference to the important relation of brushes to wages is costing many manufacturers a lot of money. With the hazy idea that "brushes are brushes," a midwest manufacturer was buying from anyone and everyone offering the lowest prices.

Low standards of brush quality were concealing low standards of workmanship. The manufacturer completely overlooked the fact that even a fully capable worker is forced to do poor work and less work with a poor brush.

Recently, this manufacturer was made aware of what his indifference to brushes was costing him. Now he is standardized on uniformly high quality Osborn Brushes. Not only are his workers doing better work and more of it per dollar of wages, but he is buying brushes less frequently because Osborn Brushes last longer.

Osborn and the Osborn Distributor in your locality can show YOU why it's good business to use good brushes. Ask about it!

THE OSBORN MANUFACTURING COMPANY

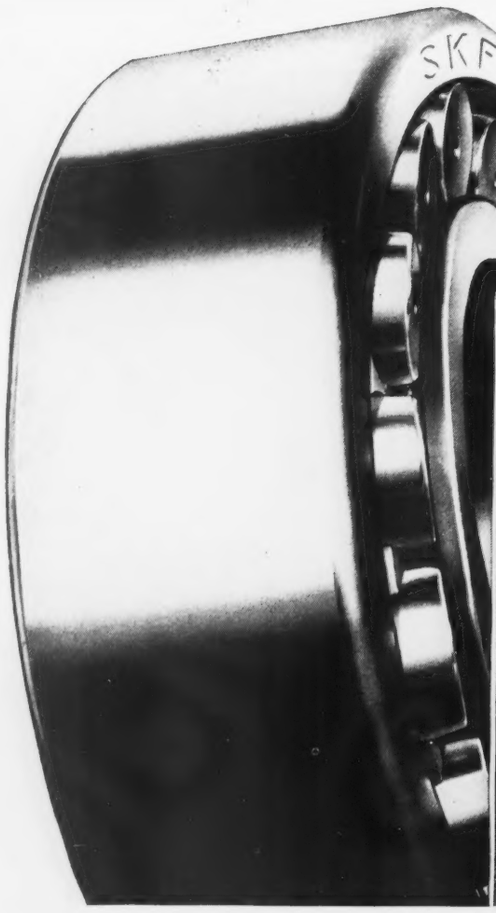
5401 HAMILTON AVENUE • CLEVELAND, OHIO

SALES OFFICES:

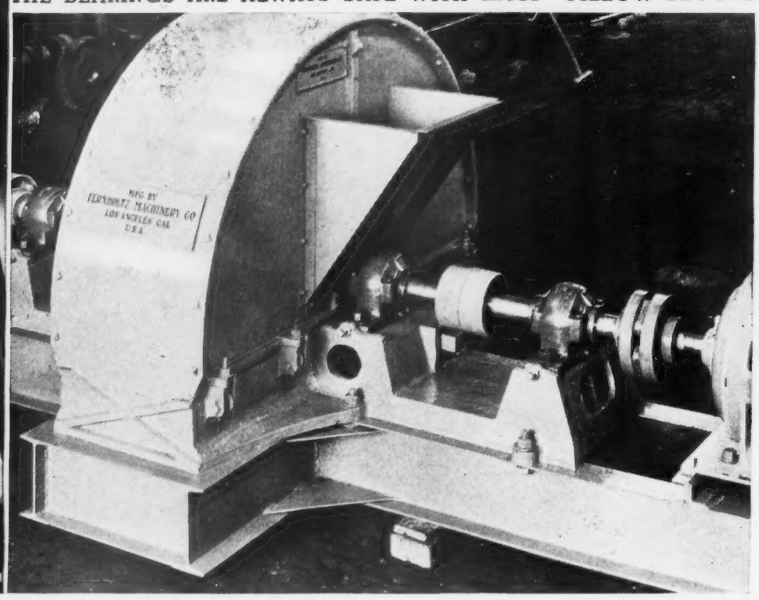
NEW YORK • DETROIT • CHICAGO • SAN FRANCISCO

Specify Osborn Brushes

• THE MOST EXTENSIVE LINE OF INDUSTRIAL BRUSHES • SERVING ALL INDUSTRIES



THE BEARINGS ARE ALWAYS SAFE WITH **SKF** PILLOW BLOCKS



MACHINES LAST LONGER

when they're equipped with SKF *Pillow Blocks*

- Only the most exacting care in the design and workmanship of SKF Pillow Blocks could assure their widespread use in all the fields of industry.

They allow elongation or contraction of the shaft without producing extraneous thrust loads on the bearing. They effectively keep lubricant *in* . . . dust, dirt and moisture *out* . . . bring down the high cost of power waste. They are strong, compact units, composed of only a few parts, and are made for shafts from 5/8" to 30" in diameter.

Daily, they are demonstrating their ability to pay for themselves within two years not only on new machines, but on old ones, too. Your nearest SKF distributor will be glad to supply you with further details.

3995

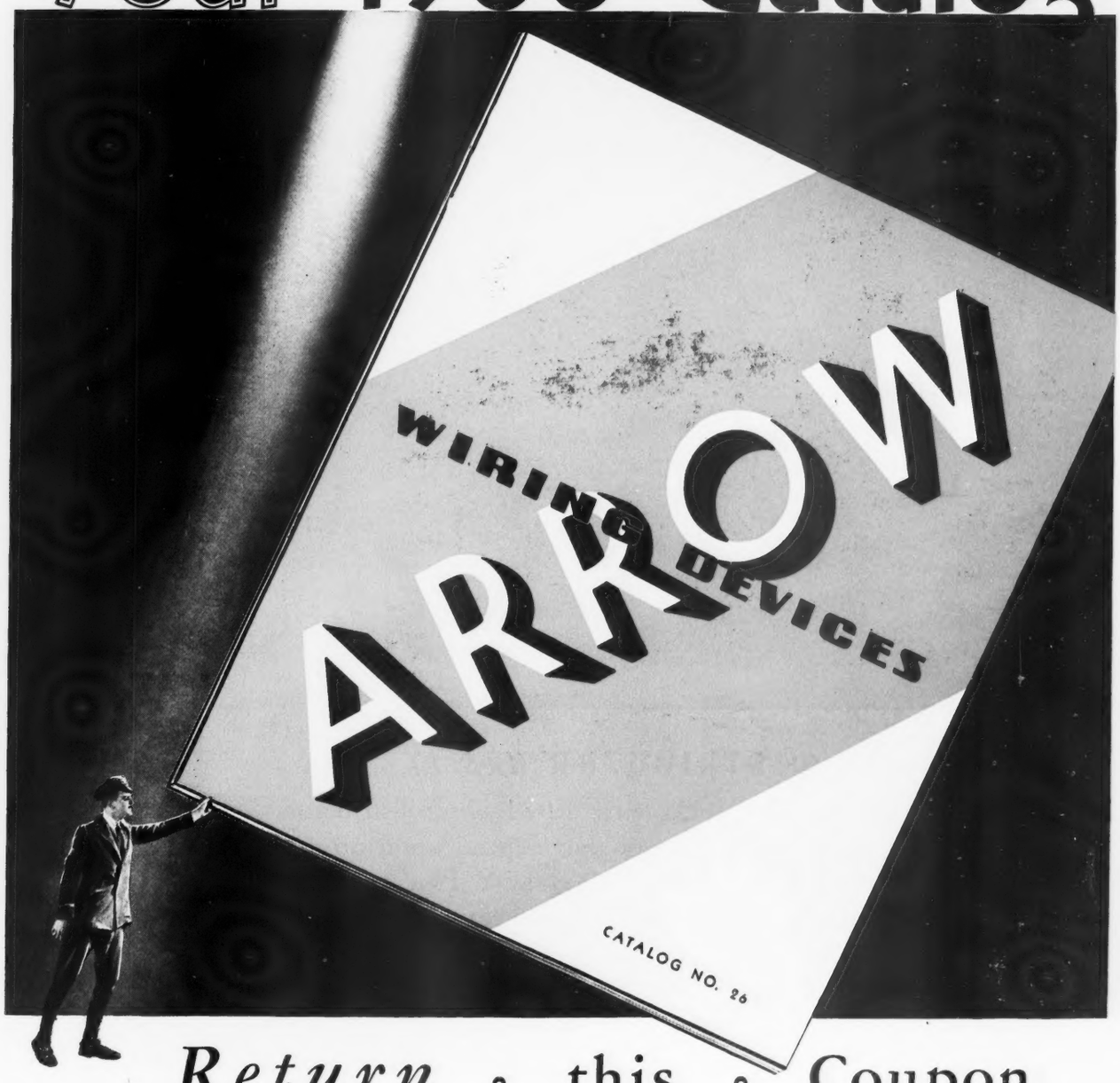
SKF INDUSTRIES, INC., FRONT ST. & ERIE AVE., PHILA., PA.

MORE THAN
1200
TYPES AND SIZES
Industry comes to SKF for unbiased bearing counsel because SKF makes practically all types of anti-friction bearings.

SKF

BALL AND ROLLER BEARINGS

Your 1938 Catalog



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for this book of *today's* complete line of ARROW developments in Wiring Devices . . . hundreds of *new* listings in quickly get-at-able form. Combined price lists and index in separate color section for handy reference. Bright, soil-proof cover identified at a glance. Every wanted wiring device made most *conveniently available* to you . . . Use the Coupon!

To ARROW ELECTRIC DIVISION, Hartford, Conn.
Send your new Wiring Device Catalog No. 26 *to*

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THE ARROW-HART & HEGEMAN ELECTRIC CO.

HARTFORD. CONNECTICUT, U.S.A.

What Kind? What Size? A LENGTH OR A CARLOAD?

WHEELING STEEL

YOUR DISTRIBUTOR *HAS IT* . . . . .

With complete stocks carried by leading distributors throughout America, you can depend upon prompt delivery of Wheeling COP-R-LOY Pipe for every type of project. Where conditions are unusually severe, where dependable, economical performance is essential, and where low cost is an important consideration, you can safely specify COP-R-LOY Pipe. It has written its own record for durability. Order COP-R-LOY tubular goods by name . . . It's Wheeling Steel. Wheeling Steel Corporation, Wheeling, West Virginia.

Whitaker Range Boilers and Special Tanks, made of COP-R-LOY, are available through your regular source of supply.

COP-R-LOY *Pipe*

Reg. U. S. Pat. Off.

IT'S WHEELING STEEL

Only SHAFER *has the simple concave roller design*

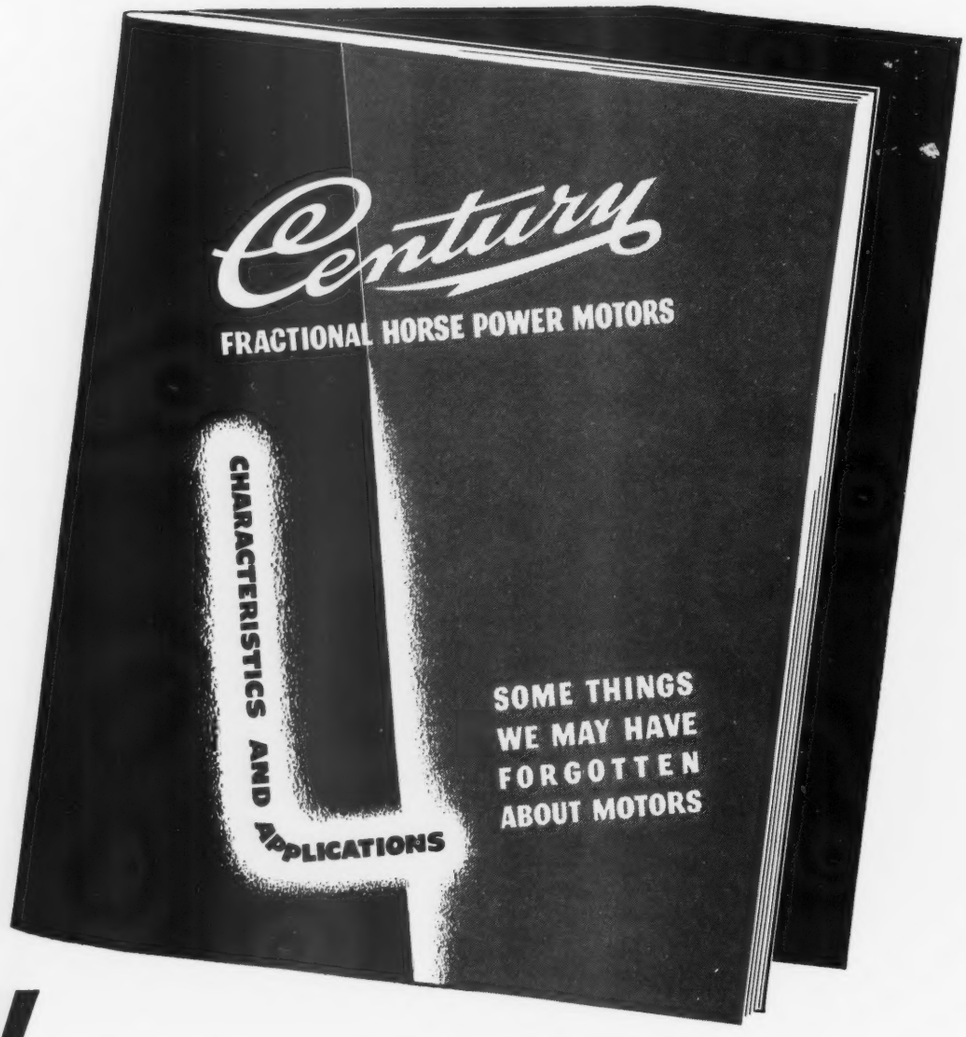
that effectively maintains free-rolling bearing action under severest operating conditions. Only Shafer combines 1. Self-alignment within the bearing itself, 2. Capacity for radial, thrust, or combined radial-thrust loads, 3. Simple adjustability.

SHAFER BEARING CORPORATION

35 East Wacker Drive, Chicago

AVAILABLE IN A FULL RANGE OF SIZES: PILLOW BLOCKS • FLANGE UNITS • TAKE-UP UNITS • HANGER BOXES • CARTRIDGE UNITS • DUPLEX UNITS • CONVEYOR ROLLS • RADIAL-THRUST ROLLER BEARINGS

EVERYTHING YOU NEED IN A ROLLER BEARING


Century
FRACTIONAL HORSE POWER MOTORS
CHARACTERISTICS AND APPLICATIONS
SOME THINGS WE MAY HAVE FORGOTTEN ABOUT MOTORS

THIS BOOK *tells..*

HOW *to* SELECT *the* RIGHT MOTOR

This New 24-page book will be of real assistance to you . . . Here is presented in helpful form information concerning the electrical characteristics of all types of Fractional Horse Power Motors—and suggestions as to how they can be most effectively applied to meet the requirements of motor-driven machinery and appliances operating in normal or abnormal surroundings . . . Fully illustrated . . . Send for your copy, if you have not received it . . . **ASK FOR BULLETIN 1039-K . . .**

CENTURY ELECTRIC COMPANY

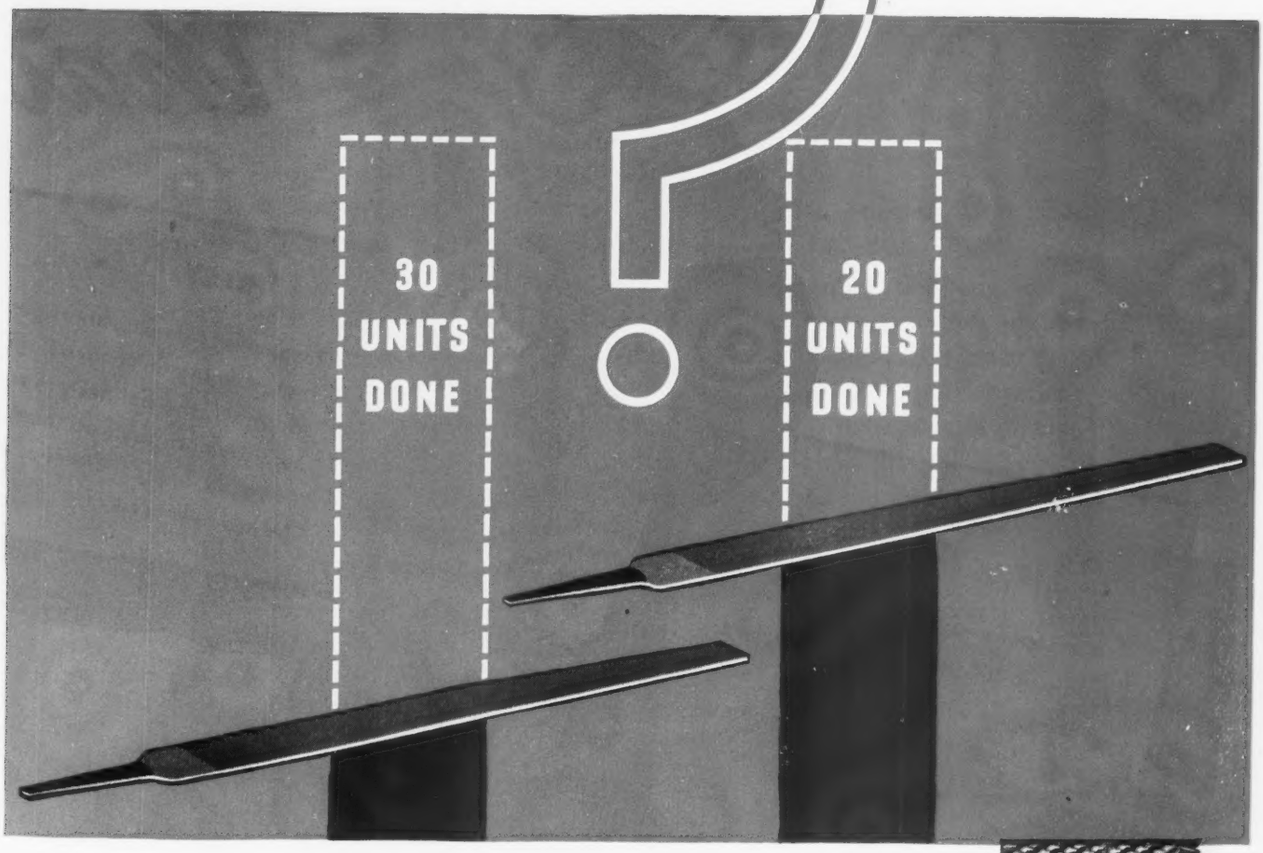
1806 Pine Street • • • • St. Louis, Mo.

Offices and Stock Points in Principal Cities

Century MOTORS

UP TO 600 HORSE POWER

DO YOU BUY FILES ON ABILITY TO REMOVE STOCK



YOUR CHOICE IS EASY...

Hand tests* made under conditions that leave no room for doubt give you a clear picture of the comparative ability of files to remove stock.

In these hand tests, rigidly made and impartially conducted, Nicholson, Black Diamond and McCaffrey Files completed 30 units of work while other brands finished only 20.

This means a machinist in your plant can increase his production by 33% if he changes to Nicholson, Black Diamond or McCaffrey Files.

His time costs you less money because he produces more. And because labor is the big expense item in filing costs, you make substantial savings by specifying one of these fast cutting brands.

Your Mill Supply dealer carries a full line of Nicholson, Black Diamond or McCaffrey Files. Nicholson File Company, Providence, R. I., U. S. A.

*TEST CONDITIONS
All Brands Concealed. Same Number of Strokes on Same Type of Metal.

A FILE FOR EVERY PURPOSE

ENGINEERING *that*

"BEST EVER"

Inspecting steam turbine bearings, running on Texaco Regal for years, the builder's representative pronounced them to be in the best condition of any he had ever seen.

17,520 HOURS

A company reports electric motors running 24 hours a day for two years . . . without servicing. Their anti-friction bearings are lubricated with Texaco Starfak.

TEXACO

SERVICE
gets results

THE Texaco lubrication engineer gets results because he gets down into the work and assists in ways and means of working out economies.

And once he finds "trouble," he has the experience to know how to clear it up.

Every day, from every part of the United States, Texaco lubrication engineers report benefits to Texaco users. This service is real, practical, vital . . . and it's available *for you.*

These trained lubrication engineers are always ready for consultation on the selection and application of Texaco Industrial Lubricants. Prompt deliveries assured through 2070 warehouse plants throughout the United States. The Texas Company, 135 East 42nd Street, N. Y. C.

BIG CUT

A $4400 lubrication cost reduced to less than $3000 is the saving effected in a year by an eastern manufacturing plant, through the cooperation of a Texaco engineer cooperating with plant personnel.

LONESOME PUMP-HOUSE

Operated by remote control, and practically never visited, an electrically-driven pump has been operating now for three years. Reason: the anti-friction bearings are lubricated with Texaco Starfak.

TEXACO REG. T. M.

INDUSTRIAL LUBRICANTS

WHAT THE STOCKADE WAS TO THE PIONEER

HOT GALVANIZING

IS TO IRON AND STEEL

There is no substitute for safety . . . When you buy galvanizing, the important consideration is not how much it costs to coat your product but rather how much real rust prevention you get per dollar . . . There is no substitute for Hot Dip Galvanizing. It applies a heavy, natural coating of approximately two and one-half ounces of molten zinc per square foot of surface and fuses it fast to the steel core. The result—the most practical and economical protection known to modern science. Patronize members of this Association and know that you are getting a genuine, quality Hot Dip job every time. Send for our specification folder—it saves you money by showing how to specify a good galvanizing job. Address American Hot Dip Galvanizers Association Incorporated, American Bank Building, Pittsburgh, Penna.

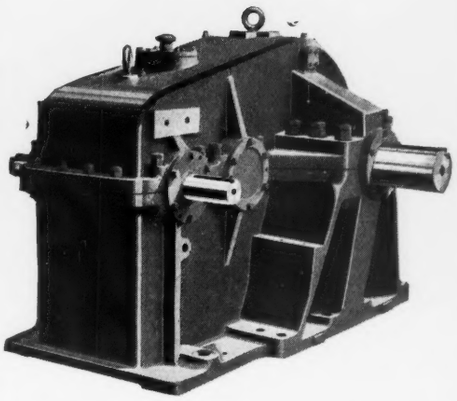
IF IT CARRIES THIS SEAL IT'S A JOB WELL DONE

OFFICIAL INSIGNIA
GALVANIZED PRODUCTS
PROTECTED BY GENUINE
HOT-DIP
GALVANIZING
AMERICAN HOT DIP GALVANIZERS ASSOCIATION INC.

BUY FROM THESE QUALIFIED MEMBERS

Acme Galvanizing, Inc., Milwaukee, Wis.
Acme Steel & Malleable Iron Works Buffalo, N. Y.
American Tinning & Galvanizing Co. Erie, Pa.
Buffalo Galvanizing & Tinning Works, Inc. Buffalo, N. Y.
Diamond Expansion Bolt Company, Inc. Garwood, N. J.
Enterprise Galvanizing Co., Philadelphia, Pa.
The Fanner Mfg. Company, Cleveland, Ohio
John Finn Metal Works, San Francisco, Cal.
Thomas Gregory Galvanizing Works Maspeth, N. Y.
Hanlon-Gregory Galvanizing Company Pittsburgh, Pa.
The Hodell Chain Company, Cleveland, Ohio
Independent Galvanizing Co., Newark, N. J.
International Derrick & Equipment Co. Columbus, Ohio
Joslyn Co. of California, Los Angeles, Cal.
Joslyn Mfg. & Supply Co., Chicago, Ill.
L. O. Koven & Brother, Inc., Jersey City, N. J.
Lehigh Structural Steel Co., Allentown, Pa.
Missouri Rolling Mill Corp., St. Louis, Mo.
The National Telephone Supply Co. Cleveland, Ohio
Penn Galvanizing Co., Philadelphia, Pa.
Riverside Foundry & Galvanizing Co. Kalamazoo, Mich.
San Francisco Galvanizing Works San Francisco, California
The Sanitary Tinning Co., Cleveland, Ohio
Standard Galvanizing Co., Chicago, Ill.
Wilcox, Crittenden & Company, Inc. Middletown, Conn.
The Witt Cornice Co., Cincinnati, Ohio

Tough!

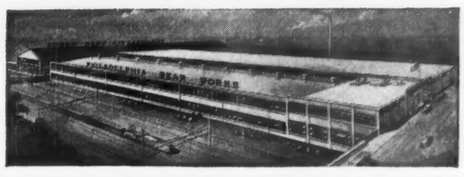


PHILADELPHIA HERRINGBONE
SPEED REDUCER

Great strength, rigidity, compactness, absolute dependability and the ability to "take it" day in and day out . . . all are inbred qualities of these widely used Speed Reducers.

Numerous power transmission requirements involve heavy shock loads at high speeds — frequent overloads — continuous back-breaking service — frequent stops and starts — many reversals, etc. —tough, trying service for any Speed Reducer, yet Philadelphia Herringbone Reducers have been used throughout the industry for years, always delivering the maximum input horsepower at the required R.P.M. . . . silently, smoothly, faithfully and with practically no attention. *Send for Catalog.*

PHILADELPHIA



Speed Reducers

PHILADELPHIA GEAR WORKS

Industrial Gears and Speed Reducers

ERIE AVENUE AND G STREET, PHILADELPHIA

Put Your LIGHTS on WHEELS

with BULL DOG
UNIVERSAL TYPE

Trol-E-Duct

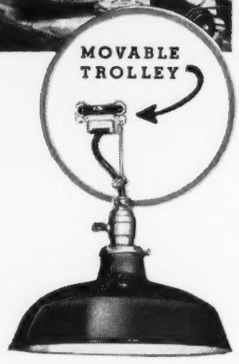
With BULL DOG Trol-E-Duct Your Lighting Can Be Readily Adapted to Both Your Building Structure and Your Equipment or Machinery Layout—

Underneath view of DUCT in which Busbars are mounted and into which TROLLEYS are inserted.

The movable, current carrying TROLLEY

Cross Sectional View, Showing Rolling TROLLEY Inserted In DUCT.

Universal Trol-E-Duct provides a lighting system which is flexible enough to conform to both the structural and the equipment layout of a building . . . At first, Duct runs may be installed to conform to the structural layout of the building; then when equipment and machinery are installed, the Trolleys (providing "Lights on Wheels") may be inserted and moved along the Duct runs to furnish ideal lighting with respect to the machinery or equipment locations . . . By the same token, of course, these "Lights on Wheels" can be moved, or added to, whenever changes in either general or specific lighting is necessary . . . Investigate this low cost Lighting Distribution System, with its flexible provisions for every present and possible future need.



Lighting Fixture attached to a TROLLEY which acts as both feeder and movable means . . . Any type of Lighting Fixture can be adapted for use with TROL-E-DUCT.

Write for Illustrated Bulletin

BULL DOG ELECTRIC PRODUCTS COMPANY

Pioneers of Flexible Electrical Distribution Systems

DETROIT, MICHIGAN

BULL DOG ELECTRIC PRODUCTS OF CANADA, LTD., TORONTO, ONT.

"MISUNDERSTANDINGS TOTALLY ELIMINATED"

Teletalk employees prefer

McCASKEY TOOL CONTROL

HOW LABOR RELATIONS WERE BETTERED by improved tool crib service in the plant of Webster Electric Company, Racine, Wis., manufacturers of Teletalk and other products, outlined by Mr. P. G. Crewe, Comptroller:

RESPONSIBILITY FIXED "McCaskey Tool Control, adopted about a year ago, has ended all contention between the employees drawing tools and our crib attendants. The inaccuracies and limitations of the old brass check system were a constant source of irritation. Responsibility now is so definitely fixed that arguments are a thing of the past to the complete satisfaction of all concerned.

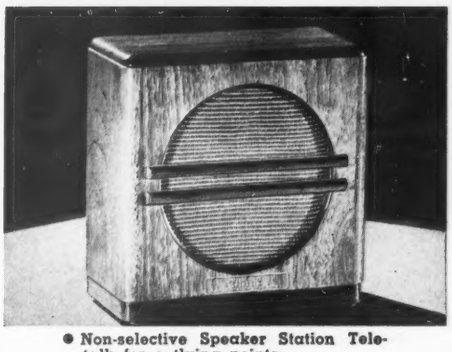
SMALLER CRIB INVENTORY "We also have a better balanced tool inventory with smaller crib stocks of numerous items. Our tool investment has been reduced and time is no longer wasted searching for tools on the production floor.

BREAKAGE REDUCED 50% "Our tool breakage has been cut down an average of 50% with very little effort. McCaskey data indicated the action to be taken and savings began almost immediately.

TOOL SERVICE SPEEDIER "Our tool service is much speedier and it has been improved in many other respects. Pressure on crib attendants has been reduced and the time spent at the crib window by otherwise productive workmen has been minimized.

BLUE-PRINT CONTROL "Our experience with McCaskey Tool Control led to an adaptation of your methods to the issuance and control of our blue-prints. This also has been satisfactory in every respect."

● Master Teletalk enables conversation selectively with multiple stations.



● Non-selective Speaker Station Teletalk for outlying points.

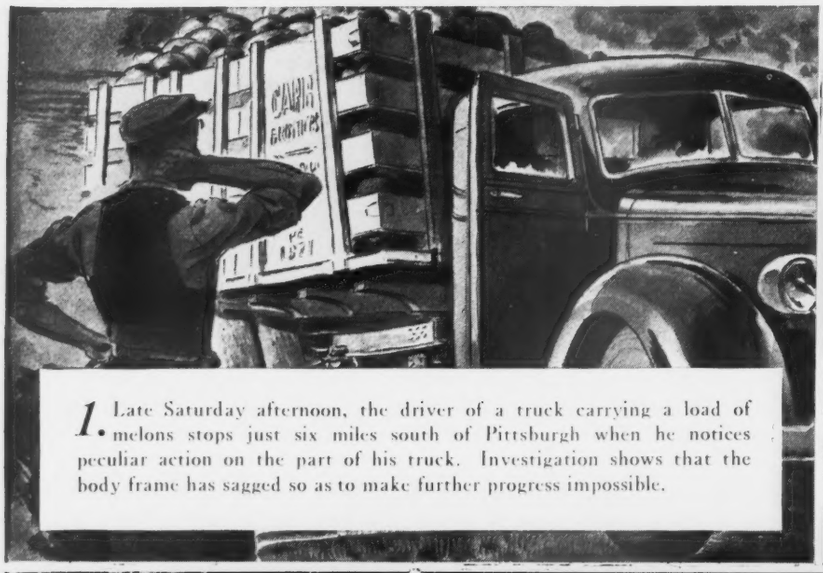
● Analysis of your tool crib requirements by an experienced McCaskey representative holds these same potential advantages for you. Call him in—no obligation—or let us send you reports of the experiences of other representative manufacturers and descriptive data.

THE McCASKEY REGISTER COMPANY, ALLIANCE, OHIO

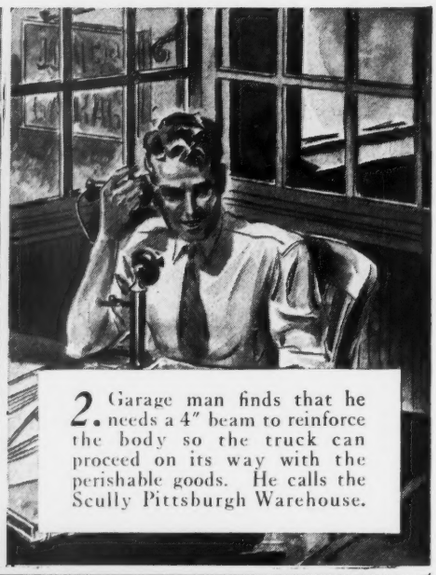
McCASKEY INDUSTRIAL CONTROLS

PRODUCTION • INVENTORY • MAINTENANCE • TOOLS • COSTS • PAYROLL

Phone call brings **"SCULLY SERVICE"** *. . . saves loss on Perishable Goods*

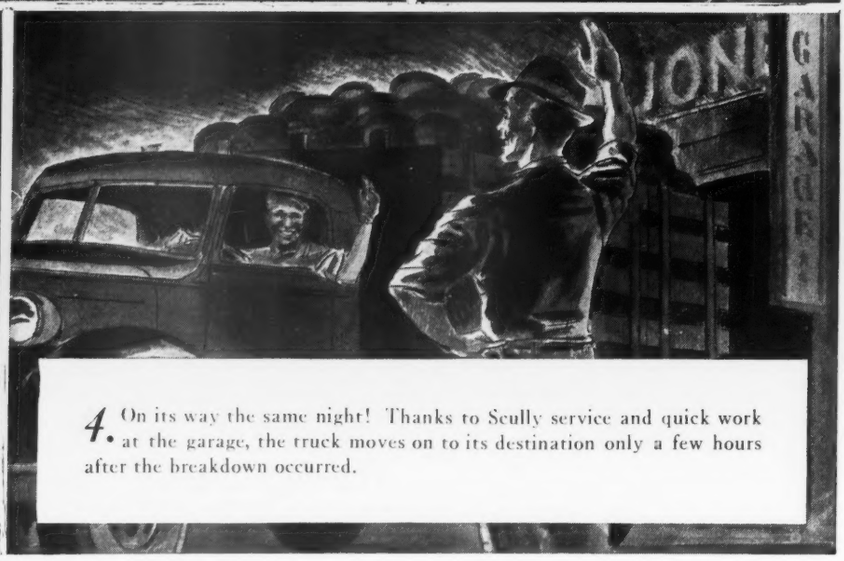


1. Late Saturday afternoon, the driver of a truck carrying a load of melons stops just six miles south of Pittsburgh when he notices peculiar action on the part of his truck. Investigation shows that the body frame has sagged so as to make further progress impossible.



2. Garage man finds that he needs a 4" beam to reinforce the body so the truck can proceed on its way with the perishable goods. He calls the Scully Pittsburgh Warehouse.

3. Saturday afternoon, but quick phone calls soon put Scully men on the job. In no time at all, the beam is cut and delivered to the garage.



4. On its way the same night! Thanks to Scully service and quick work at the garage, the truck moves on to its destination only a few hours after the breakdown occurred.

Scully Service

SMALL orders—large orders—rush or not, they all get Scully Service. Call Scully in emergencies and for your regular requirements, too. Every one of the eight Scully warehouses carries a big stock of steel, steel products, copper and brass.

Next time try Scully. Phone, wire or write the nearest Scully warehouse. Send for a free copy of our handy, complete Stock List and Reference Book. Remember: Scully Service is your insurance against delay.

SCULLY STEEL PRODUCTS COMPANY

Distributors of Steel, Steel Products, Copper and Brass

CHICAGO • NEWARK, N. J. • ST. LOUIS • BOSTON • ST. PAUL
CLEVELAND • PITTSBURGH • BALTIMORE

UNITED STATES STEEL

When the end of 1937 rolls around and industry adds up the items of plant operating cost directly attributable to friction, an amazing total of *four billion dollars* will appear at the foot of the column! A staggering loss to American industry in a single year.

What is being done to reduce it? A relentless battle is being waged against the wastes of friction every day by Gulf's large staff of trained lubrication engineers. These men, real lubrication specialists, work with plant operating men to make machines produce on a more efficient basis.

In their broad experience they have found literally dozens of ways to save money by better selection of lubricants and better application methods.

Plant managers who take advantage of this cooperative service, available from Maine to Texas, save money—in reduced costs for power and for maintenance, and in improved production from each machine in the plant.

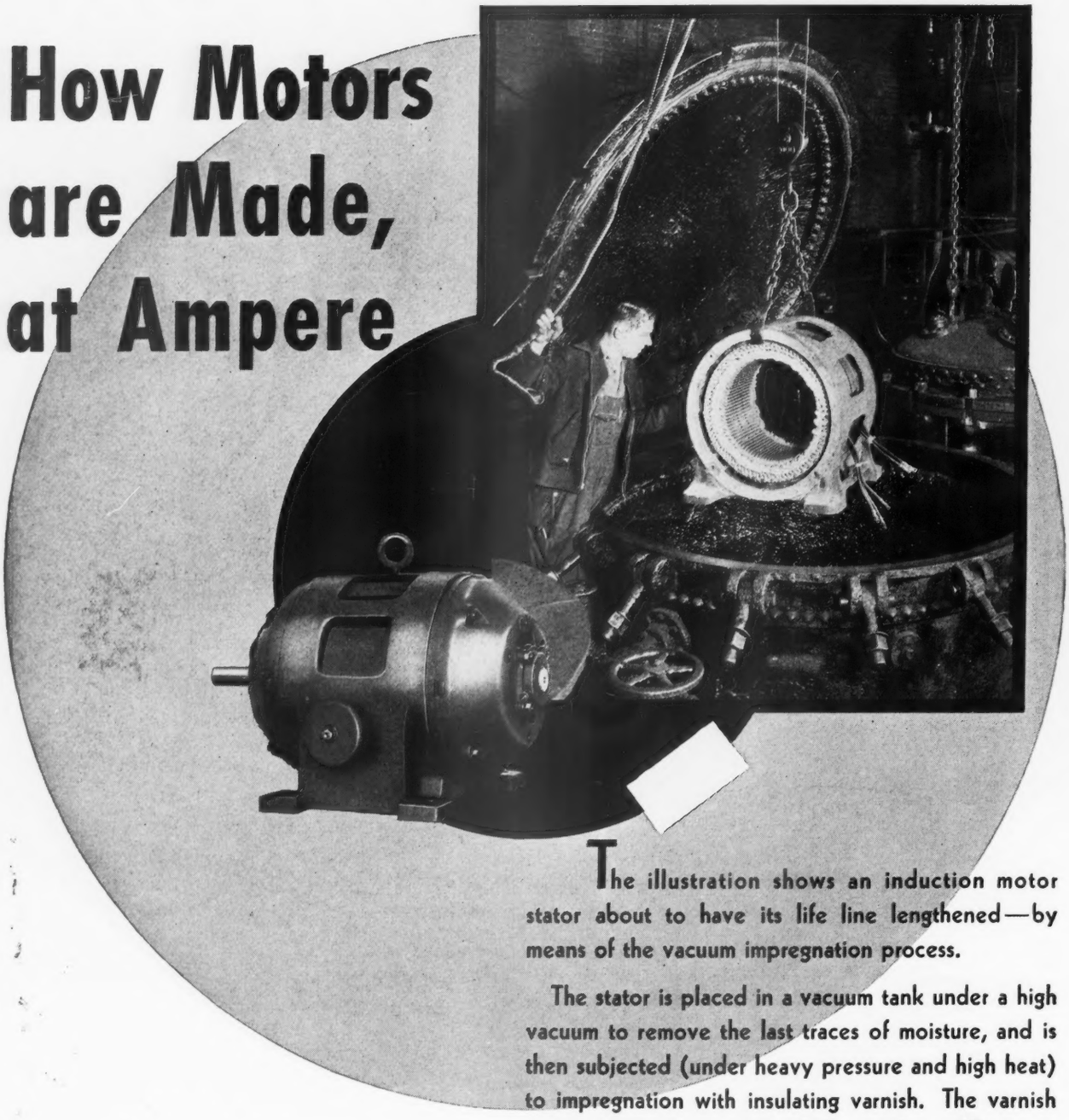
Let a Gulf engineer recommend—from Gulf's complete line of 553 oils and greases—the lubricants which will help *you* reduce the wastes of friction in *your* plant.

GULF INDUSTRIAL LUBRICATION

Gulf Oil Corporation ★ Gulf Refining Company

GENERAL OFFICES: GULF BUILDING, PITTSBURGH, PA.

How Motors are Made, at Ampere



The illustration shows an induction motor stator about to have its life line lengthened—by means of the vacuum impregnation process.

The stator is placed in a vacuum tank under a high vacuum to remove the last traces of moisture, and is then subjected (under heavy pressure and high heat) to impregnation with insulating varnish. The varnish penetrates to every part of the windings, filling any air pockets that may have been present, and making the windings dirt, oil and moisture resisting to the highest possible degree.

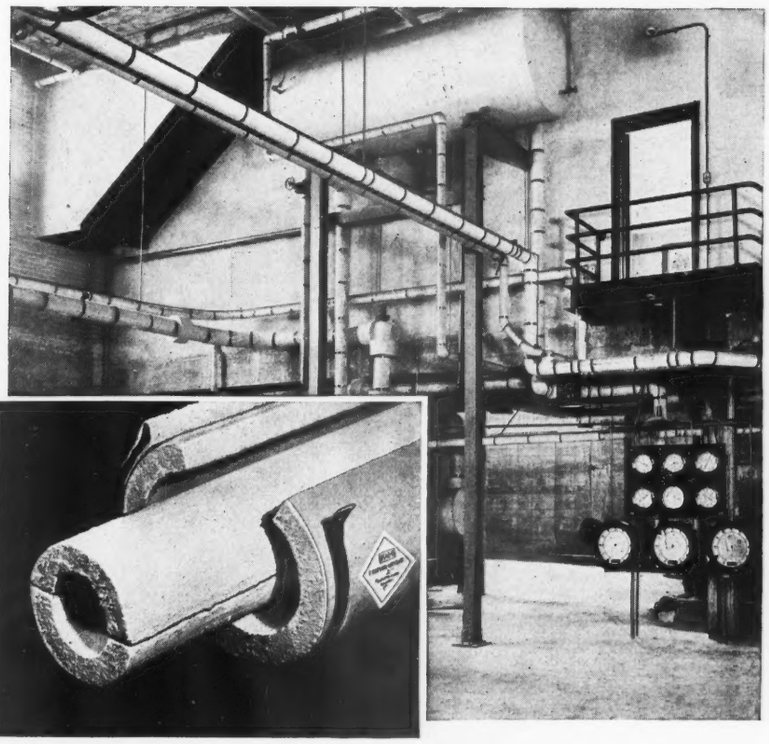
This process is not used generally in the making of motors because it is an expensive process requiring very expensive equipment. It is used at Ampere—that is the reason Crocker-Wheeler motors last so long on the job.

CROCKER-WHEELER
TRADE MARK REG. U.S. PAT. OFF.

EXCELLENT ENGINEERING

CROCKER-WHEELER ELEC. MFG. CO.
Main Office and Works: AMPERE, N. J.
SALES OFFICES IN PRINCIPAL CITIES

Heat insulation that pays permanent dividends



K&M

"FEATHERWEIGHT" 85% MAGNESIA

You start to save money the moment you install 85% Magnesia insulation. And it is a saving that never ends. For not only is 85% Magnesia one of the most efficient heat insulators ever developed . . . its durability is almost unique.

Floods, water leakage and steam do not affect it. It has been submerged in sunken ships, salvaged, dried out and re-applied with no loss in its high efficiency. For temperatures up to 600°F., no other material can offer more enduring economy.

K & M "Featherweight" 85% Magnesia, like all products of this company, has behind it more that 60 years' experience in the development and large-scale production of asbestos and magnesia products. The K & M line is complete, and specialized for the needs of each plant.

Send for information

"Featherweight" 85% Magnesia Pipe Insulation, Blocks and Lagging • Air Cell Insulations in sections and blocks • Asbestos Pipe Insulation in sections • Asbestos Insulation in sheets and blocks • Asbestos Insulating Cements • Asbestos Packings: rope, cord and sheet • Asbestos Gaskets, Gasket Tapes and Cloth • Friction Materials.

Underline the products on which you want full information and mail this coupon today.

Name_____

Name of Firm_____

Address_____ 8-7

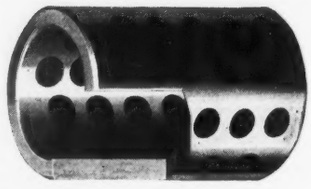
KEASBEY & MATTISON COMPANY
AMBLER, PENNA.

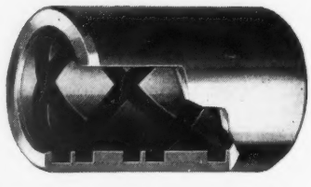
WHEN you buy Graphited Oil-less Bearings make sure that the bearing is properly designed or you may get less than the performance you expect.

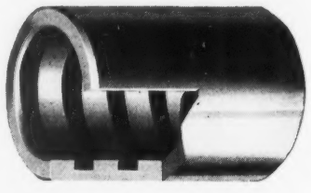
Graphited Oil-less Bearings should be designed and made exactly to meet the requirements of the application under consideration. The style of grooving employed for the graphite composition, the apportionment of bearing contact surfaces (bronze to graphite), are points that have everything to do with the service rendered by the bearing.

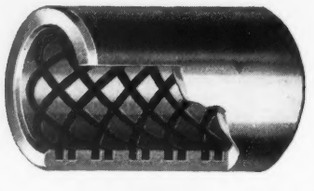
Bunting engineering makes it possible to extend the use of this type of bearing to many new applications. Flanged Bushings and Thrust Washers of any size or design also can be obtained in Bunting Graphited Bronze.

We will gladly aid you, without cost or obligation, in making up specifications for Graphited Oil-less Bearings and quote you on such requirements. The Bunting Brass & Bronze Company, Toledo, Ohio . . . Branches and Warehouses in all Principal Cities.







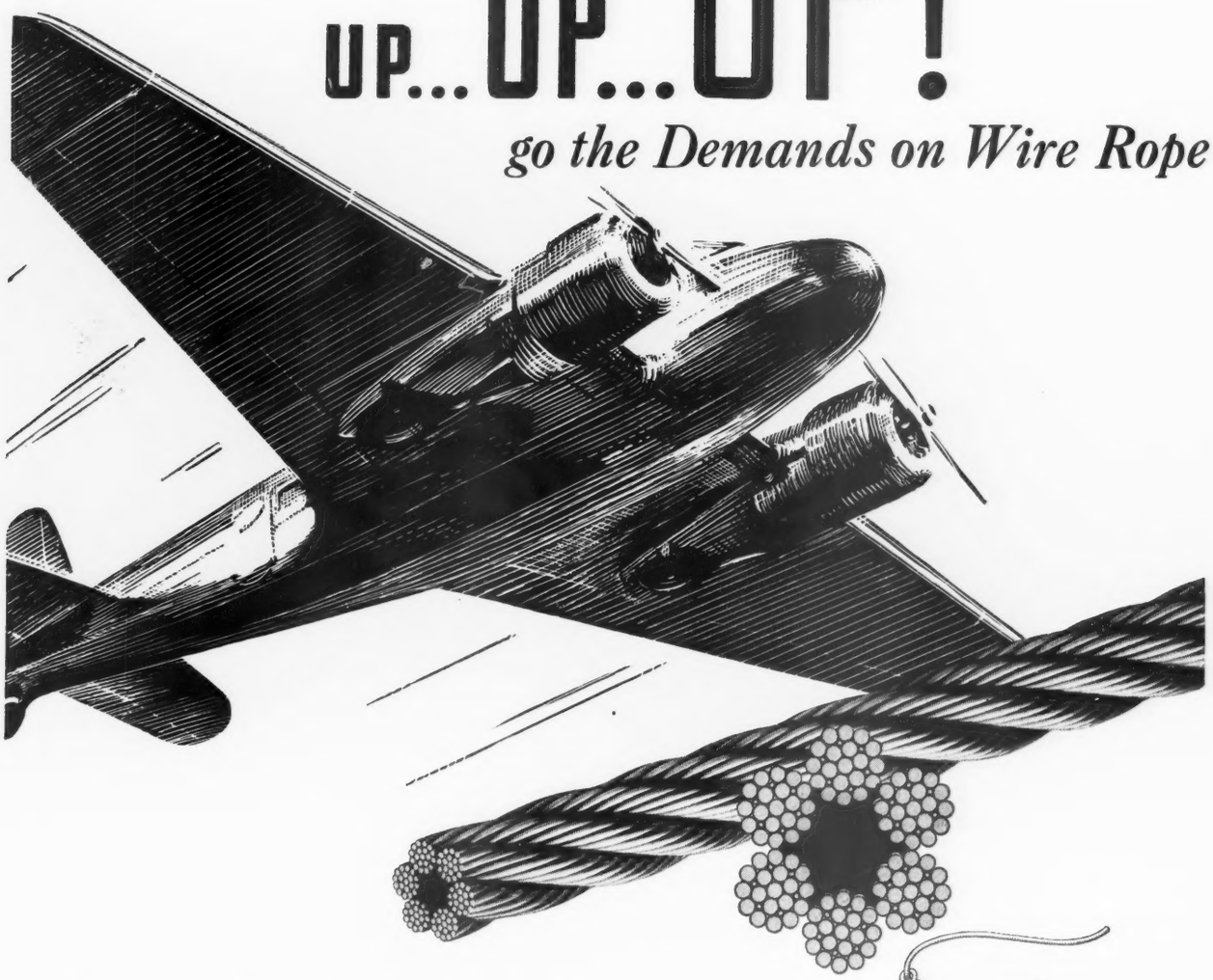


BUNTING Bunting **Quality**

BRONZE BUSHINGS • BEARINGS
MACHINED AND CENTERED BRONZE BARS
BABBITT METALS

UP... UP... UP!

go the Demands on Wire Rope



Severest Requirements met by ROEBLING "BLUE CENTER"

To REDUCE operating costs to a minimum, it has been necessary in many instances to increase the capacity of wire rope rigged equipment. Speeds have been stepped up... loads boosted. As a result, wire rope has been called on to meet increasingly severe service.

For many applications where service conditions are severe, ROEBLING "Blue Center" WIRE ROPE has exactly met requirements. *It has proved conclusively that it assures lowest general average operating cost.*

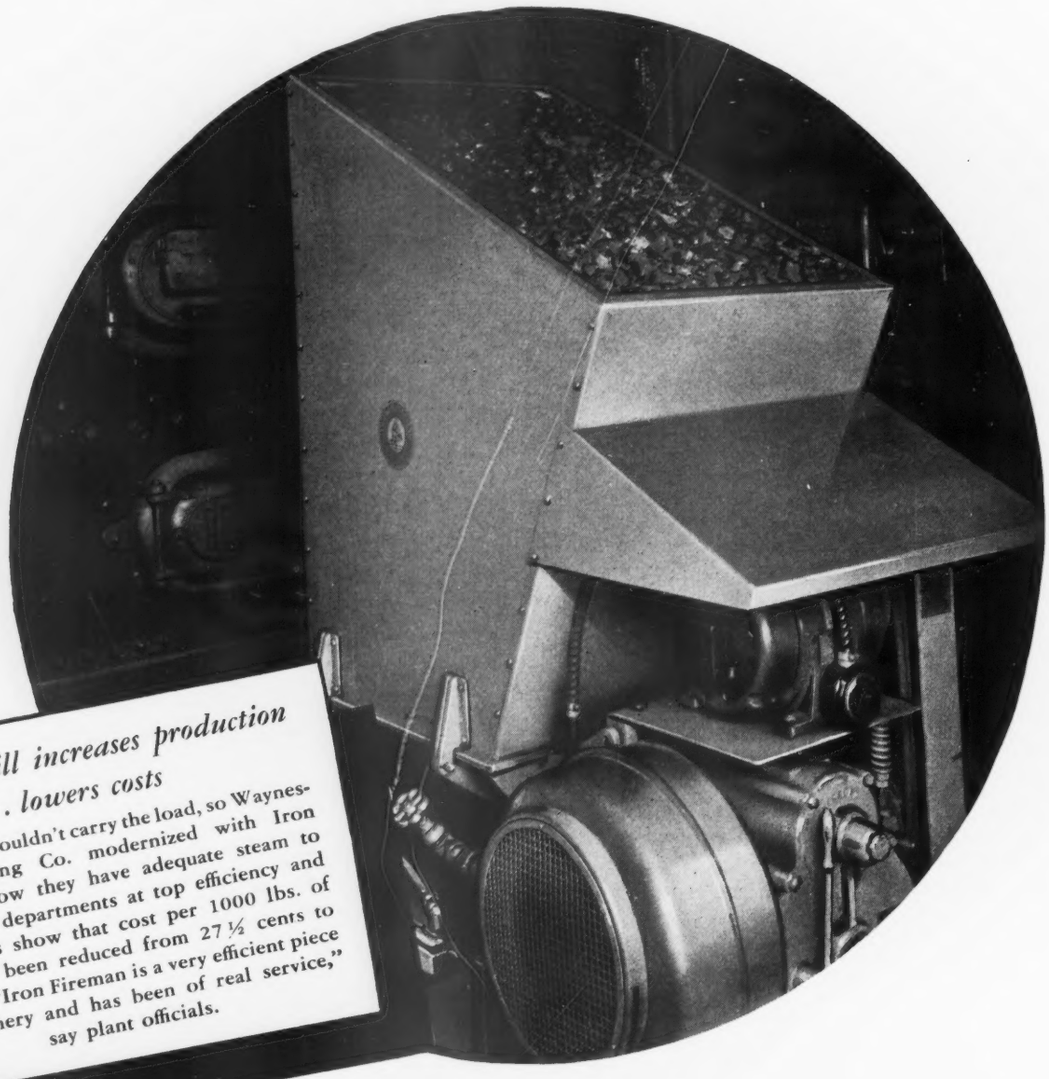
If you are seeking a wire rope of superlative quality, one which will give you maximum safety and durability, at rock-bottom operating cost, investigate Roebling Blue Center... *the highest development in Roebling wire rope manufacture!*

JOHN A. ROEBLING'S SONS CO.
TRENTON, N. J. *Branches in Principal Cities*

The Highest Development in Roebling Wire Rope
1 STRONGER
Wire of highest strength consistent with ductility and toughness
2 TOUGHER
Provides maximum resistance against wear, sudden shocks, vibration
3 SAFER
Unequalled for uniformity of quality
4 SAVING
Insures lowest general average operating cost

ROEBLING ✸ BLUE CENTER

Modernize with



Textile mill increases production . . . lowers costs

Hand-firing couldn't carry the load, so Waynesboro Knitting Co. modernized with Iron Fireman. Now they have adequate steam to operate all departments at top efficiency and boiler tests show that cost per 1000 lbs. of steam has been reduced from 27½ cents to 19 cents. "Iron Fireman is a very efficient piece of machinery and has been of real service," say plant officials.

Waynesboro Knitting Co., Waynesboro, Pa., where an Iron Fireman stoker installation has made estimated annual fuel savings over hand-firing of $1839.16 or 32%.

IRON FIREMAN

IRON FIREMAN

The world's standard of stoker value for power boilers developing up to 500 h. p.

STEAM costs go down when Iron Fireman takes over the firing job. Fuel and labor costs are cut. Smoke nuisance is ended. Boiler efficiency is increased. These are not claims, but facts—established in thousands of boiler rooms where Iron Fireman has turned in years of continuous, trouble-free service.

Iron Fireman stokers are produced by the world's largest stoker manufacturer. They are designed, built and serviced by a strong national organization of skilled and experienced stoker men. When you buy Iron Fireman you buy the standard of stoker quality as well as the outstanding leader in the industry. There are far more Iron Fireman stokers operating today than any other make.

Accept this Free Offer

An Iron Fireman factory engineer or your nearest dealer is authorized to make a free fuel and firing survey for you. He will analyze your power plant fuel costs and make a written report setting forth present facts compared with a dependable estimate as to possible savings and betterments. This service takes time, intelligence and money, but it will be made gladly and without obligation if you are interested in learning what Iron Fireman can do for you. Fill out the coupon and mail to the factory. Iron Fireman Mfg. Co., Portland, Oregon; Cleveland; Toronto. Dealers everywhere.

☐ Make free firing survey.
☐ Send catalog.

Name.....

Address.....

Type of boiler.....

(Mail to Iron Fireman Manufacturing Company, 3034 W. 106th Street, Cleveland.)

Iron Fireman Excels in the 7 essentials of a successful stoker

1. FUEL CONTROL. Iron Fireman hopper construction facilitates a constant movement of coal to the feed worm, which in turn has scientifically designed flights for the proper metering of coal to the fire.

2. COAL CONVEYING. Iron Fireman's silent, powerful, three-speed transmission operates the cold rolled steel feed worm that conveys coal from hopper or bin to the retort.

3. CARBURETION. The retort or "carburetor" of Iron Fireman stokers achieves a correctly balanced mixture of fuel and air for most efficient carburetion. Tuyere blocks and dead plates are made of rugged, long-lasting iron.

4. COMBUSTION. All of the factors that make for efficient combustion have been scientifically worked out by Iron Fireman engineers and tested in thousands of installations.

5. CONTROLS. Iron Fireman controls are designed by an engineering organization that has had the greatest experience in the industry in developing stoker instruments. There is a complete line of exclusive Iron Fireman controls to regulate and safeguard stoker operation.

6. PROPER INSTALLATION. Correct installation of a stoker is just as important as correct design and construction. With fourteen years of experience in thousands of boiler rooms, Iron Fireman has developed installation procedure to a high state of perfection.

7. CONTINUING RESPONSIBILITY. A stoker is no better than the organization that stands behind it. Iron Fireman makes stokers exclusively and is the largest manufacturer in the industry. Your Iron Fireman will never be "an orphan."

Only an Iron Fireman can give Iron Fireman results

Automatic Coal Burner

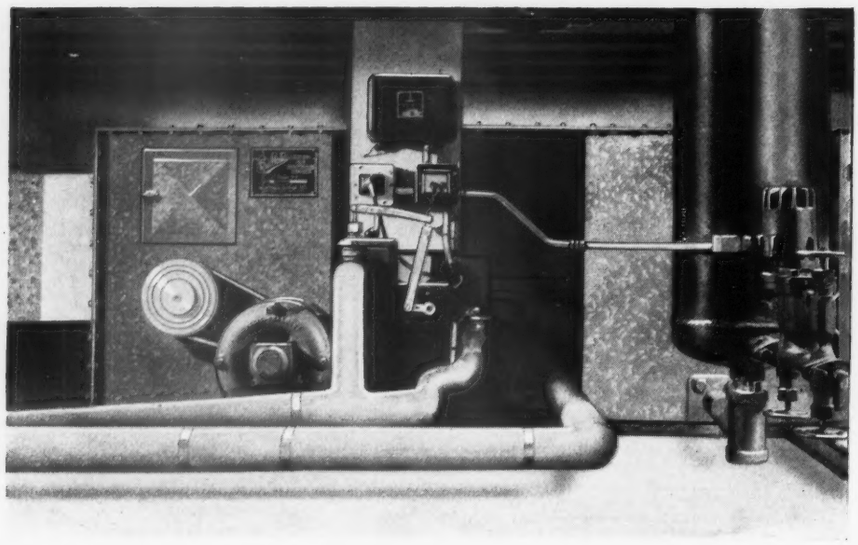
When You *Plan* Be Sure You *Get*

AIR CONDITIONING
AIR CONDITIONING

—Ask Your Consulting Engineer About

"Buffalo"

P. C. UNITS



This "Buffalo" P. C. Cabinet does a complete air conditioning job.

"Buffalo" P. C. Cabinet built for 30 ton capacity. Note the few coil connections necessary.

• These complete, compact units are built to do the *whole* job of air conditioning. Therefore, you can keep them busy the year 'round cooling and dehumidifying in summer; heating and humidifying in winter; cleaning the air at all times.

Furthermore, when you specify "Buffalo" equipment you automatically get the benefit of a long and wide experience in building equipment to solve air conditioning problems throughout the world.

So we repeat—"When you plan air conditioning be sure you get air conditioning." The safe way is to have "Buffalo" build your units to fit your exact needs.

Bulletin 501-B gladly mailed on request.

See our exhibit at the Fifth International Heating and Ventilating Exposition, Grand Central Palace, New York, January 24 to 28, 1938

BUFFALO FORGE COMPANY

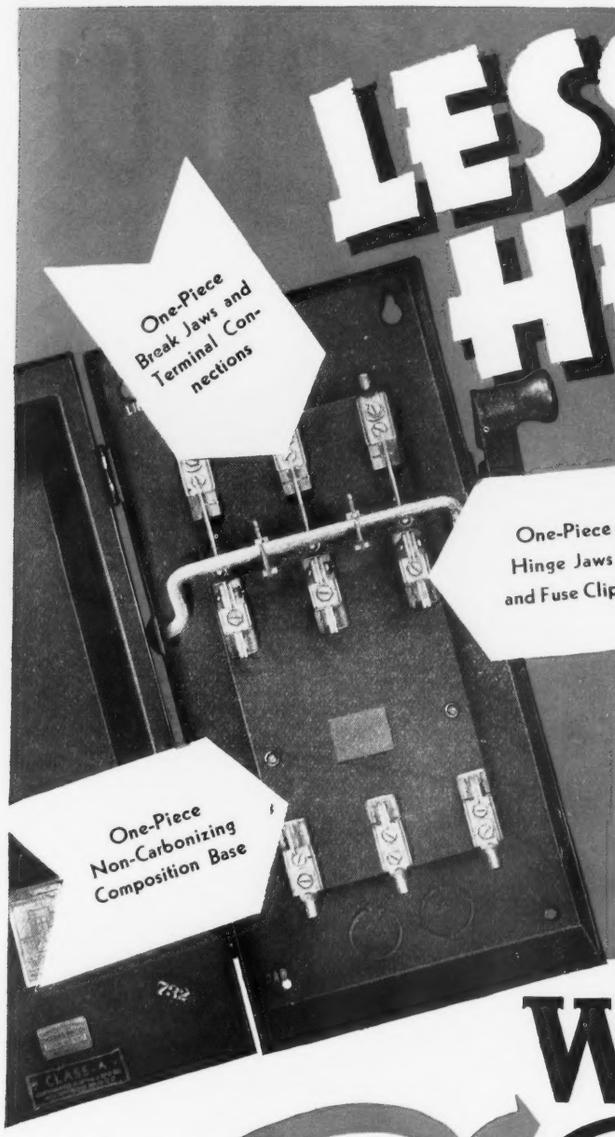
471 BROADWAY, BUFFALO, N. Y.

Branch Engineering Offices in Principal Cities. In Canada: Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

LESS HEATING

because they're made with

FEWER, SIMPLER PARTS


One-Piece Break Jaws and Terminal Connections
One-Piece Hinge Jaws and Fuse Clips
One-Piece Non-Carbonizing Composition Base

Westinghouse DE-ION *Safety Switches*

Switches in ratings of 575 and 600 volts are equipped with the famous Westinghouse "De-ion" Arc Quencher. In the past, arcs have been broken by "stretching." The "De-ion" quencher confines, divides and extinguishes arcs instantly—obviously preventing concentration of burning heat on contacts or arc barriers.

●Maintenance is lower on Westinghouse Safety Switches because there are fewer parts to become loose, and cause harmful heating. One-piece or milled-and-ground copper parts do away with most of the customary screws and bolts. The one-piece composition base is non-carbonizing. Fuses and contacts are inspected by simply opening the cabinet.

Savings on repairs and replacements are carried still further by two additional exclusive features. The Diamond-Pointed Break Jaw and Extended Blade construction confines beading to areas which fall *outside* the contact surfaces. The "De-ion" Arc Quencher in 575 and 600-volt types confines, divides and extinguishes the arc, preventing flashover and damage to working parts.

One-piece copper parts on switches rated 200 amperes and below are readily removable from the front. On switches 400 amperes and above, copper parts are of milled-and-ground type of construction, rear-connected. Base assembly is removable from the front. All sizes and ratings, Types A, C and D. Call your local:

Westinghouse Office Electrical Wholesaler Electrical Contractor Motor Dealer

Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

J 20303

A SWITCH FOR EVERY PURPOSE . . . AND ★ MOTORS ★ "DE-ION" LINESTARTERS ★ NOFUZE CIRCUIT BREAKERS

Is there someone helping himself TO YOUR PROFITS?

● *Rid your plant of this blackguard, "Obsolete Equipment." Production interrupted through delays in intra-plant transportation . . . lost motion due to unnecessary handling of materials . . . unused storage space and costly repairs, these and a hundred and one other wastes are the direct results of an inadequate and obsolete material handling system. A condition that is costing your company hundreds of dollars each year — a condition that can be quickly remedied with a little careful study. Mercury offers a complete line of efficient and modern equipment and Mercury engineers are specialists in the solution of difficult product handling operations.*

1 "BANTY" GAS TRACTOR is a compact three wheel machine of ample speed and power. An economical unit to operate, it is adaptable to a wide range of industrial hauling. Fully described in Bulletin 160.

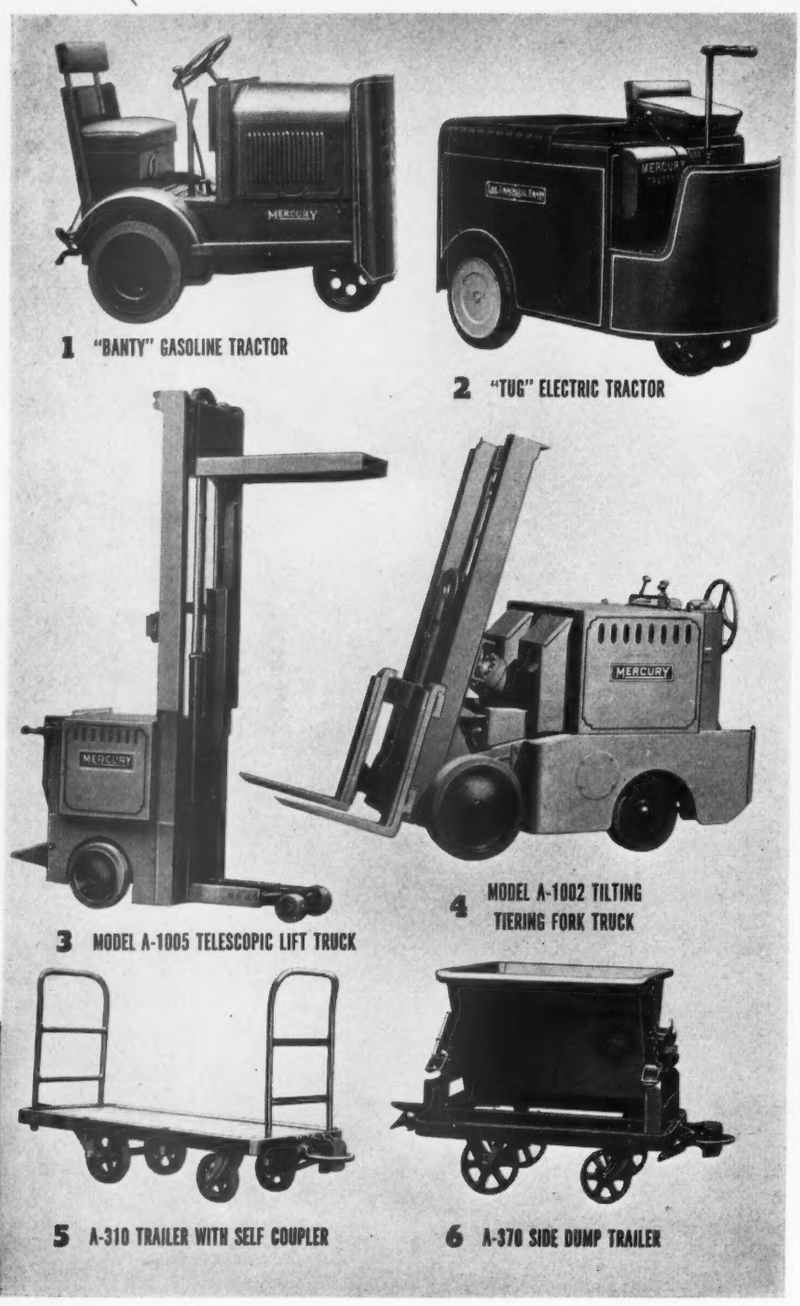
2 "TUG" ELECTRIC TRACTOR is an improved motive-power unit of recent design. It is available in either three or four wheel types and in two capacities for medium and heavy duty service. Bulletin 210.

3 MODEL A-1005 TRUCK is a telescopic elevating platform machine of 3,000 lbs. capacity. The Mercury line of lift trucks covers a range of capacities up to 10,000 lbs. and low lift, high lift and telescopic lift types. Request folder of lift truck bulletins.

4 MODEL A-1002 FORK TRUCK is a pallet handling vehicle available with or without tilting uprights, with fork elevation up to 12 feet and in a wide range of capacities. Send for Bulletin 165-4.

5 "A-310" TRAILER is a castor steer industrial vehicle of 2 tons capacity. Adopted as the standard unit for marine terminal, freight house and industrial service, it is available in almost any size and with special superstructures or hitches. Bulletin A-100 contains full specifications.

6 "A-370" SIDE DUMP TRAILER is a castor steer industrial trailer for handling loose or bulk material. It is available in capacities up to 1 cu. yd. Fifth wheel vehicles in capacities to 2 cu. yds. are also available. Write for bulletin A-170.



1 "BANTY" GASOLINE TRACTOR

2 "TUG" ELECTRIC TRACTOR

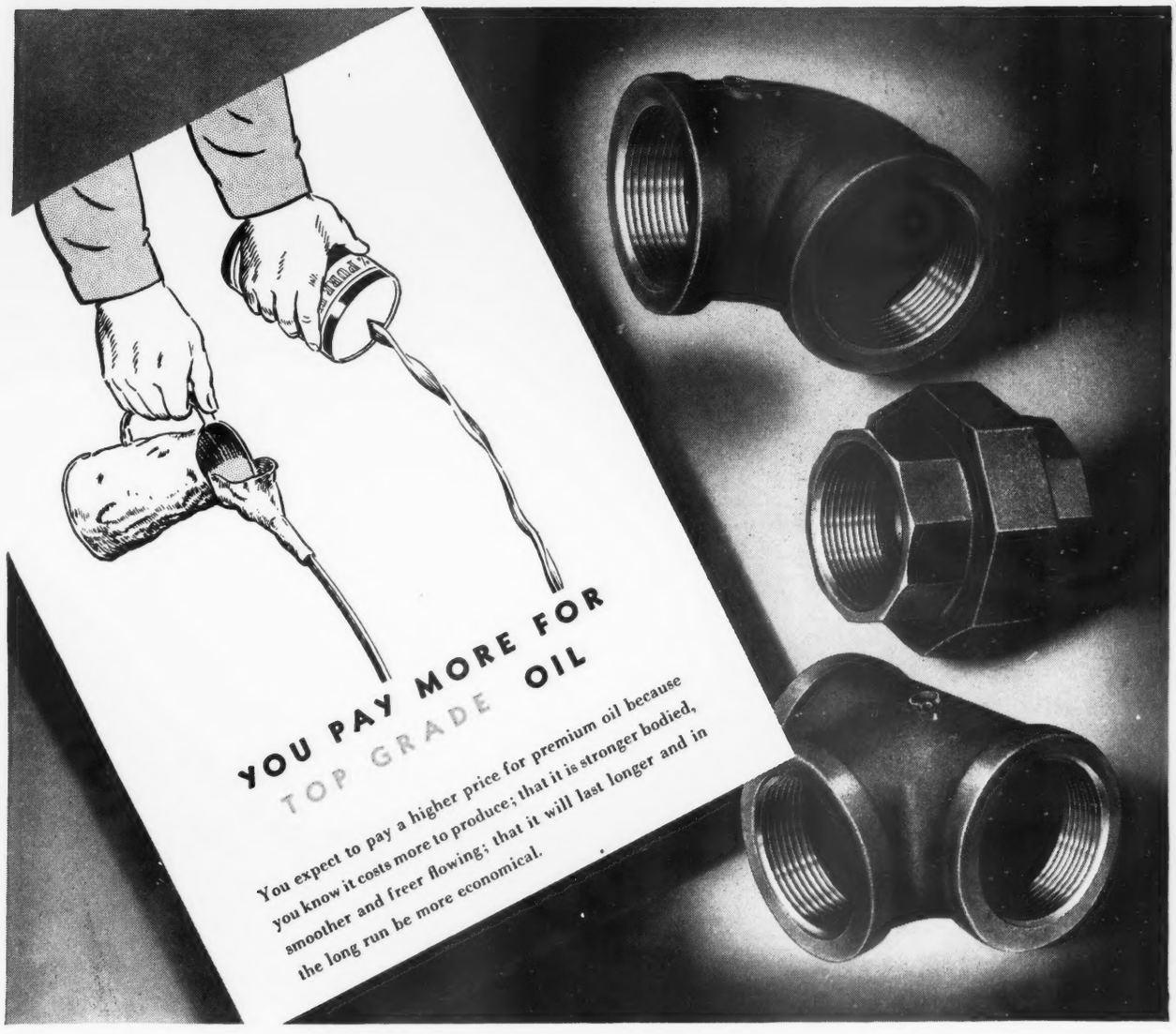
3 MODEL A-1005 TELESCOPIC LIFT TRUCK

4 MODEL A-1002 TILTING TIERING FORK TRUCK

5 A-310 TRAILER WITH SELF COUPLER

6 A-370 SIDE DUMP TRAILER

MERCURY
MANUFACTURING COMPANY
4110 S. HALSTED STREET, CHICAGO, ILLINOIS


YOU PAY MORE FOR
TOP GRADE OIL
You expect to pay a higher price for premium oil because you know it costs more to produce; that it is stronger bodied, smoother and freer flowing; that it will last longer and in the long run be more economical.

You pay NO MORE for GRINNELL AIR FURNACE Malleable Iron Fittings

Buy pipe fittings as you buy oil and you would expect to pay more for Grinnell AIR FURNACE fittings. Economy begins immediately with quicker, easier installation. Special care in manufacture assures sharp, accurate threads for tight, trouble-free joints. Just the right chamfer starts each fitting with the first turn. *Yet They Cost No More Than Other Malleable Iron Fittings.*

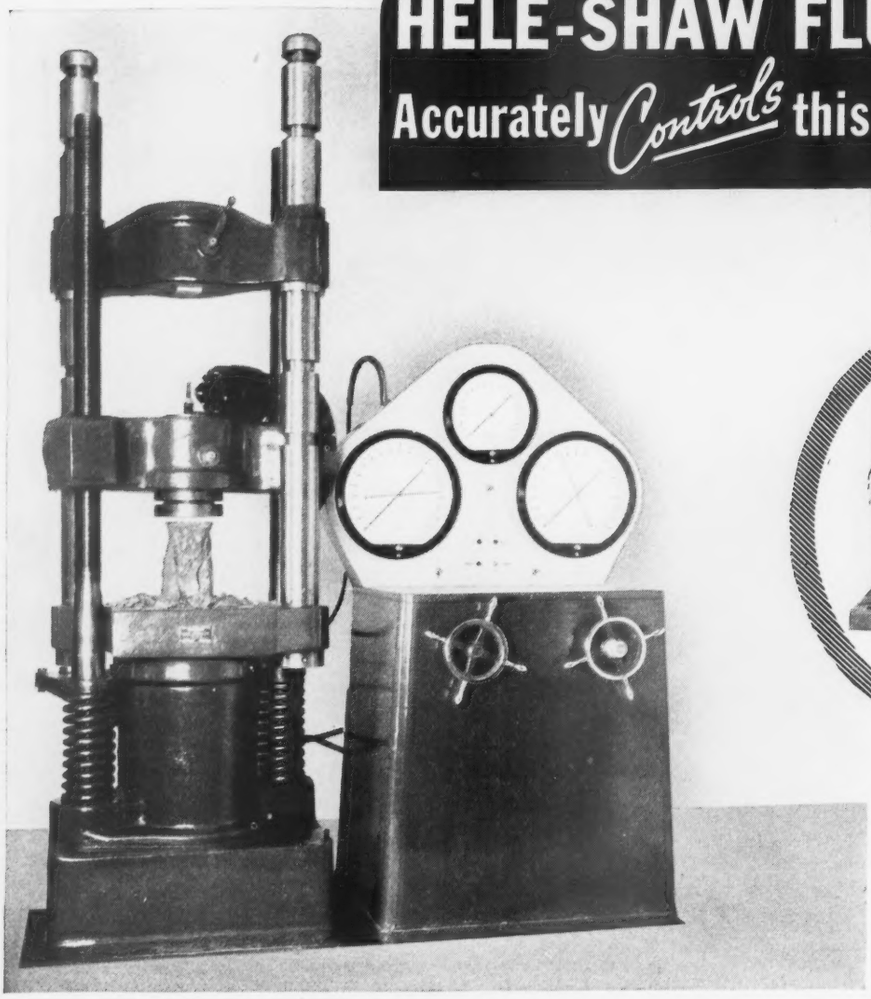
Grinnell AIR FURNACE Process produces malleable iron that is tough, fine grained, and free from flaws. Smooth, streamlined cores assure free flow. *Yet They Cost No More Than Other Malleable Iron Fittings.*

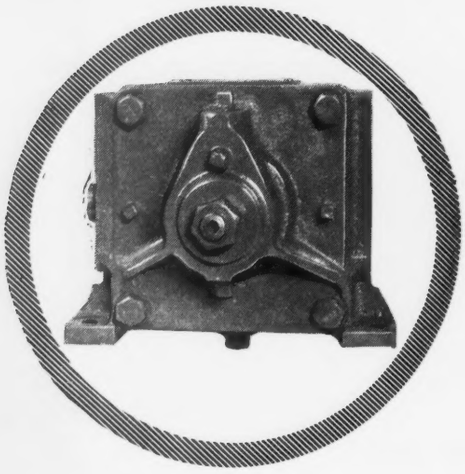
Send for the 144-page Catalog 4. Contains complete data on every fitting made by Grinnell—malleable iron, cast iron, bronze, steel — screw or flanged. Grinnell Co., Inc., Executive offices, Providence, R. I. Branch offices in principal cities of U. S. and Canada.

GRINNELL

WHENEVER PIPING IS INVOLVED

HELE-SHAW FLUID POWER
Accurately *Controls* this Testing Machine





This illustration is actually one-fifth the size of the Hele-Shaw Pump that powers the 300,000 lb. Southwark-Emery Testing Machine.

This 300,000 pound Southwark-Emery Universal Testing Machine crushes concrete specimens or pulls apart steel bars . . . The ease with which it performs these tasks compels you to ask "How is it done?" . . . It's *done* with Hele-Shaw Fluid Power. A small Hele-Shaw Pump, occupying a space only 10" x 9⅛" x 7⅝", sends *Fluid Power* (oil under high pressure) to the testing machine. Hele-Shaw Fluid Power is subject to exceptionally accurate control. A touch on a handwheel applies Hele-Shaw Fluid Power g-r-a-d-u-a-l-l-y, precisely, to the specimens. This is necessary to simulate actual loading conditions or to duplicate testing conditions in order to permit accurate comparison of various samples. Hele-Shaw Fluid Power is widely used in hydraulic press-type machines because of its high pressure and because it is so readily controlled either manually or automatically. Rams driven by Hele-Shaw Fluid Power can be adjusted over a wide range of speeds . . . and can be stopped or started instantaneously. Look into the many advantages of Hele-Shaw Fluid Power for producing and accurately controlling linear or rotary motion . . . motion which may be varied in both speed and direction. Our new catalog gives detailed information. Write for it.

AMERICAN ENGINEERING COMPANY

2426 ARAMINGO AVENUE, PHILADELPHIA, PA.

A-E-CO HELE-SHAW PUMPS, MOTORS AND TRANSMISSIONS

Other Products: A-E-CO Taylor Stokers, A-E-CO Lo-Hed Monorail Electric Hoists, A-E-CO Marine and Yacht Auxiliaries

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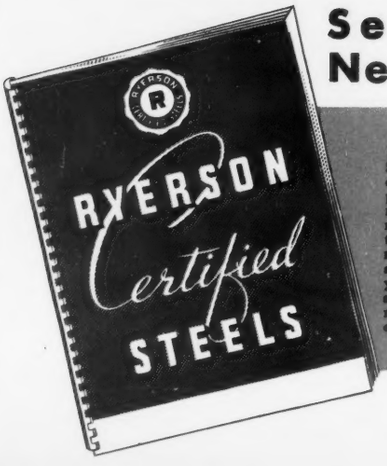
R

CERTIFIED STEELS

CARBON STEELS
STAINLESS STEELS
ALLOY STEELS

Cost No More . . .



Send for New Book

Ryerson Certified Steels are the result of many years of planning—developing new specifications—new methods of control—and complete readjustment of stocks. Let us tell you the complete story. Tear out and mail card for your copy of this new book.

Mail this Prepaid Card

Please send me your new book explaining how Ryerson Certified Steels will save time and money.

Name _____ Position _____

Company _____

Local Address _____

City _____ State _____

K4

Ryerson Certified Steels

Uniform High Quality—At No Extra Cost

For many years we have been planning and preparing. Specifications were made more accurate and inspections more rigid. The task was slow and difficult but now at last we are able to certify to the known uniform high quality of all Ryerson steels.

A big step forward is taken on alloys, with a plan never before attempted by a steel-service company.

Whole heats of alloy steels, of ideal analyses, are selected, tested and data prepared.

This data including chemical and physical properties, actual heat treatment response, etc., is sent along with every shipment. The heat treater then knows exactly what is in every bar and how to secure the best possible results.

These special services have been developed to meet the growing needs of industry and are offered without increased cost or obligation.

If you are not already taking advantage of this unique plan, we urge you to call in your nearest Ryerson representative who will be glad to give you the complete story.

The new book showing how Ryerson Certified Steels can save time and money is now ready. Mail Prepaid Post Card below for your copy.

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S. A. E. 2315, 2320, 2330, 2335, 2340, 2345, 2350, 3115, 3120, 3130, 3135, 3140, 3250, 4140, 4615, 6145, 52100; Rycase (hot rolled machine straightened); Rytense A. A. (hot rolled).

Cold Drawn Alloys
S. A. E. 2315, 2320, 2330, 3115, 3120, 3135, 3140.

Heat Treated Alloys
Ryco (hot rolled, machine straightened); Rycrome (hot rolled, cold drawn, machine straightened); Nikrome "M" (hot rolled, machine straightened); Ry-Ax and Ry-Arm.

Stainless
Allegheny Stainless sheets, plates, rounds, squares, hexagons, flats, angles, pipe, tubing, bolts, nuts, etc. in a variety of finishes.

Cold Finished Steels
Standard Shafting; turned ground and polished; Special Accuracy Stock; Rycase High Manganese Screw Stock; S. A. E. 1020, 1035, 1112, 1120, etc.

Tool Steels
Ryerson B. F. D. Die Steel; Ryerson "Shock" Steel; Ryerson V. D. Steel; Ryerson High Speed Tool Steel; Ryerson Special High Speed Tool Holder Bits.

Special Sheets
21 special quality sheets. Also all standard sheets such as plain black galvanized, corrugated, etc.

General Steel Products
Beams; Channels; Angles; Tees; Zees; Plates (17 kinds); Spring Steel; Tire Steel; Refined Iron; Boiler Tubes and Fittings; Bolts; Screws; Nuts; Washers; Rivets.

Floor Plate, Stair Tread
Inland 4-Way Floor Plates and Traffic Plates; Firm-tread Diamond Pattern Floor Plate and Traffic Plates; Mason Safety Treads, etc.

Welding Rods
19 Kinds of electrodes including improved stainless steel rods, shielded arc type rods, and special processed rods, 8 kinds of acetylene rods.

Building Products
New billet and rail steel reinforcing bars, spirals, electrically welded wire fabric, expanded metal, reinforcing mesh, caisson rings, sheet piling, bank vault reinforcing, safety treads.

Allied Products
Ryertex Bearings, Babbitt Metal, Solder, Flux, Curb Strip, Wire and Wire Rope, Chain, Slings, Slip and Grab Hooks, etc.

TRANSMISSION BELTING · MULTIPLE V BELTS · FRACTIONAL HORSEPOWER BELTS · FARM BELTING · BUCKET ELEVATOR BELTING · GRAIN ELEVATOR BELTING · CONVEYOR BELTING GRAIN CONVEYOR BELTING · CANNERS' CONVEYOR BELTING GRADER BELTING · HOG SCRAPER BELTING · AXLE LIGHT BELTING · AIR HOSE · STEAM HOSE · STEAM IRON HOSE · WATER HOSE · WELDING HOSE · AGRICULTURAL SUCTION HOSE AGRICULTURAL SPRAY HOSE PAINT SPRAY HOSE · BREWERS' HOSE · CREAMERY HOSE GARDEN HOSE · GASOLINE HOSE · CHEMICAL HOSE ACID HOSE · SAND BLAST HOSE · SAND SUCTION HOSE CONTRACTORS' SUCTION HOSE · HARD RUBBER SUCTION HOSE · TANK WAGON HOSE · TANK CAR HOSE · HOSE COUPLINGS DREDGING SLEEVES ASBESTOS SHEET PACKING RED RUBBER SHEET PACKING · ASBESTOS PACKINGS · FLAX PACKINGS DUCK AND RUBBER PACKINGS · HYDRAULIC PACKINGS · VALVE STEM PACKINGS · MAN HOLE GASKETS · HAND HOLE GASKETS · CLOTH INSERTED AND PURE GUM TUBINGS BRAKE LININGS AND BRAKE BLOCKS FOR EVERY INDUSTRIAL NEED

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BUILT FOR THE JOB
QUALITY VALUE SERVICE

Be Sure It's "Thermoid" on Your 1938 Requisitions!

In the face of mounting labor and material costs, 1938 is bound to demand new "highs" in production efficiency... new "lows" in maintenance overhead.

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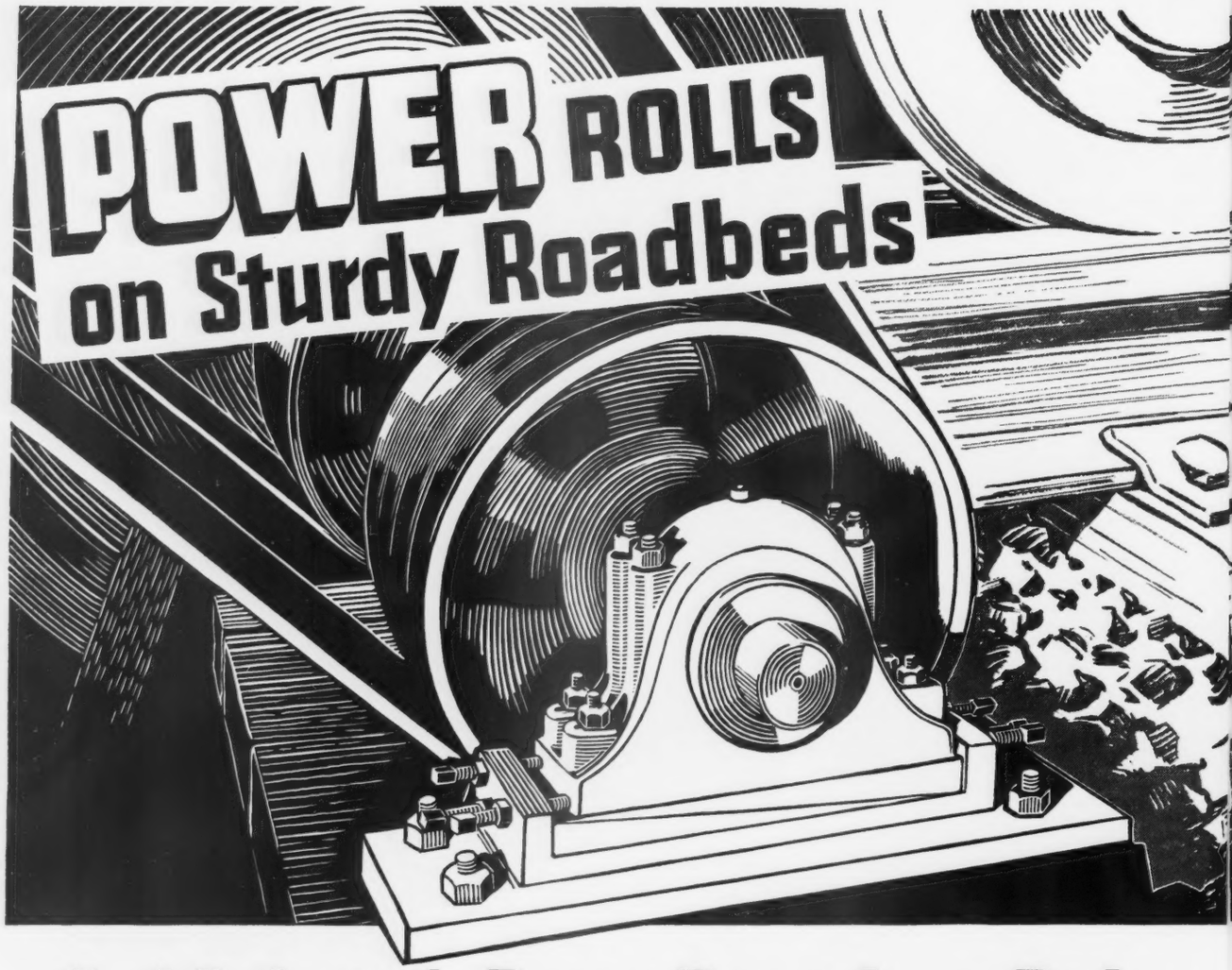
Thermoid

THERMOID RUBBER, DIVISION OF THERMOID COMPANY, TRENTON, N. J.



And Industry's Power Depends on Dodge Rolling Bearings for Smooth Riding . . .

The power-ways of industry depend on Dodge Rolling Bearings for long, efficient and trouble free service. Between the generation of power and its ultimate utilization this rugged power transmission equipment prevents costly wastes and insures continuous service.

In practically all plants and industries Dodge Transmission Equipment is respected for the soundness of its design and the integrity of its manufacture. There is added value in the name "Dodge."

There is a Dodge Bearing, whether Hanger, Pillow Block or Unit Mount for every service —either built into production machines or available for power transmission lines. For normal or heavy service—for excessive dust or water conditions—there is a Dodge Bearing designed and built for the particular job in hand — all completely assembled, factory adjusted, prelubricated units, all ready to install on the shaft.

Put your power transmission problems up to Dodge and you'll be sure of getting *"The Right Drive For Every Job."* Dodge paves the way for dependable power!

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MISHAWAKA, INDIANA, U. S. A.

DODGE
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New

Our complete new Catalogue A206 of Dodge Rolling Bearings is now ready for mailing. A copy will be sent on request.

There Is Added Value in the Name Dodge!

"RAW WATER TURBIDITY INCREASES 3200% IN TWO HOURS!... but Permutit equipment at Kent Manufacturing Company clarifies and softens it perfectly"

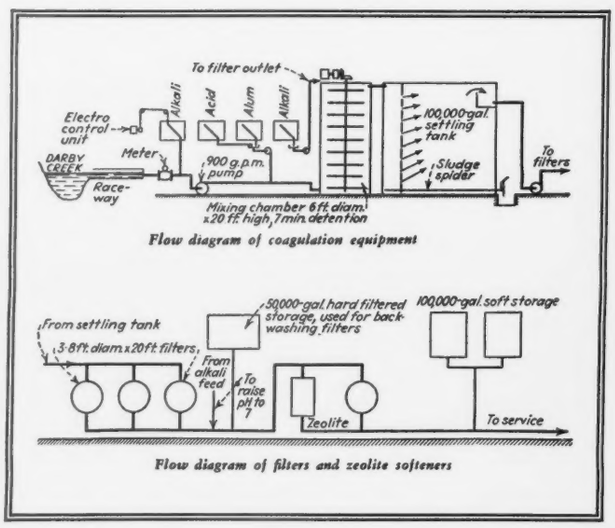
"Mud, mill wastes and chlorophyll are contaminating factors with which our Permutit equipment successfully contends," says Mr. Albert Rose, Plant Chemist

■ "Since 1843 the Kent Manufacturing Company has been using water from Darby Creek for its woolen and worsted mill at Clifton Heights, Pa.," says Mr. Rose, Plant Chemist.

"Other mills upstream pour dye waste and other waste liquors and effluents into the stream . . . storm water carries into it torrents of mud and silt . . . overhanging trees shed leaves to decay in the creek, liberating chlorophyll.

"The net result is a water supply containing a mixture of muck and pigment suspended in the water . . . a water supply where turbidity may rise from 60 ppm to 2,000 ppm in a 2-hour rain . . . in short, a water supply that would seem formidable indeed for any textile mill to cope with.

"In practice, however, it is not at all difficult . . . thanks to the efficiency of our Permutit-equipped filter plant and water softening installation. The flow diagram shows the set-up. Net results are: The effluent of the filters is consistently maintained at virtually zero turbidity, irrespective of variables in the water supply. Color is held under 5. Hardness is kept at zero."



Flow diagram of coagulation equipment

Flow diagram of filters and zeolite softeners

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Water Conditioning for Any Industry . . . Any Plant

Permutit can supply water conditioning equipment to meet any condition or combination of water turbidity, hardness, corrosiveness, iron content, bad color, or bad taste or odor. At your request . . . and at no expense or obligation to you . . . Permutit engineers will be assigned to study your specific water conditioning problem and make recommendations. Also free Permutit booklets are available covering all types of water conditioning for industrial and power plant requirements. Please address your inquiry to The Permutit Company, Dept. R , 330 West 42nd Street, New York, N. Y.

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"A.W." STANDARD DIAMOND PATTERN—HALF SIZE
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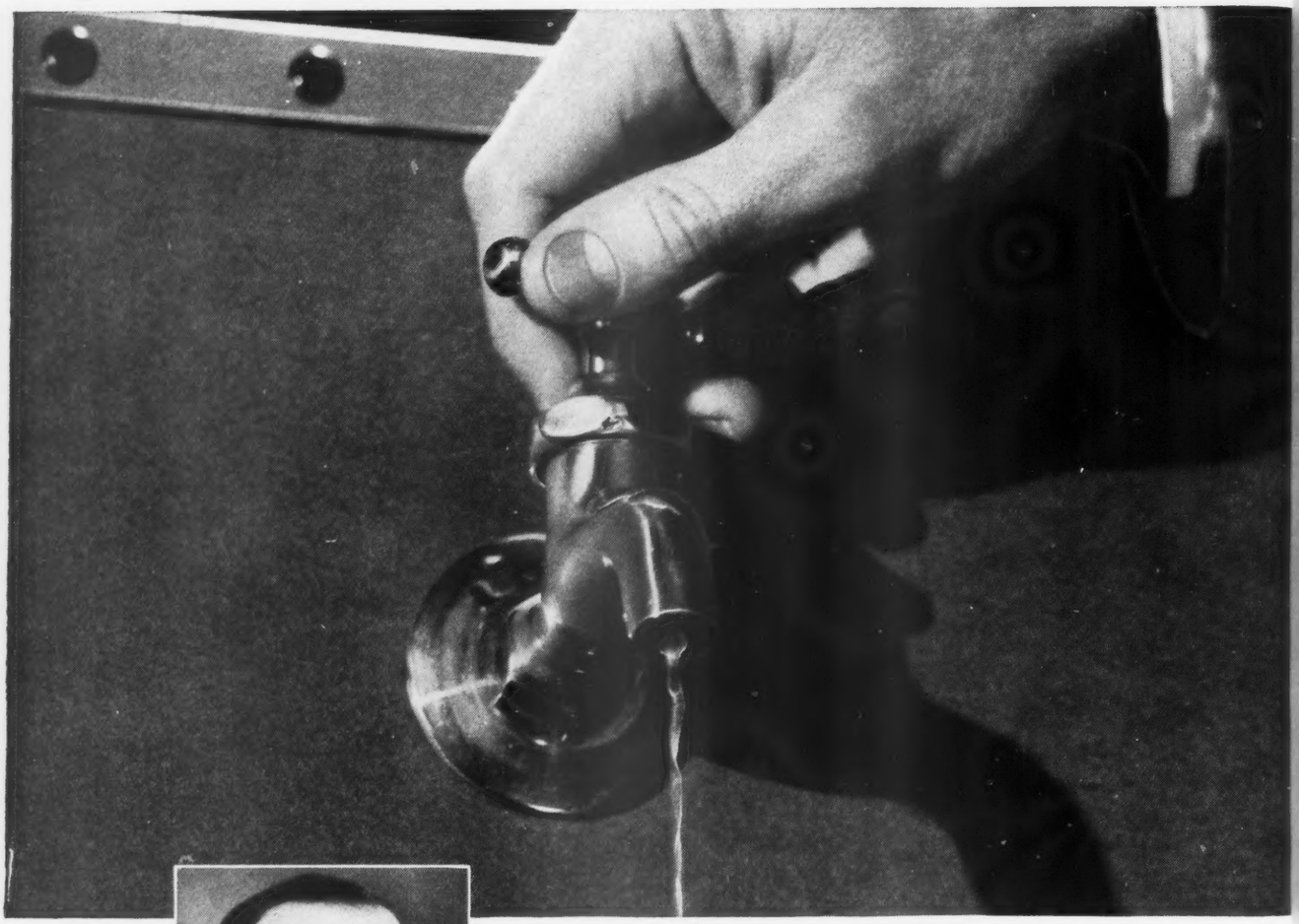
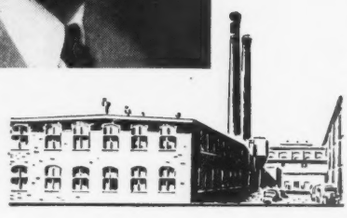


Comer Turley, mechanical superintendent, Pepperell Mfg. Co., Lindale, Georgia

It paid Pepperell to replace antiquated, deficient electric wiring

With approximately 2,000 motors in the plant of Pepperell Mfg. Co. at Lindale, Ga., burn-outs have been so reduced by installing over-size feeders that in five years there has not been a single case of rewinding on a spinning-frame, loom, or card-room motor because of overload. "The practice of installing over-size feeders is good insurance and saves on power bills," says Comer Turley, Mechanical Superintendent, "yet it involves only a small additional investment since labor cost is the same. We design feed lines for a load from 50% to 100% greater than immediate requirements."



Anaconda Wire &

General Offices: 25 Broadway, New York • Chicago Office: 20 North Wacker Drive

ff a dripping faucet

—why not stop invisible electrical leaks?

Neglecting electrical circuits costs factory owners thousands in breakdowns . . . high power bills

YOU can *see* a faucet dripping. But an overloaded electric circuit may be wasting money in the form of heat losses without your ever knowing it. Only the treasurer, wondering why bills are so high, suspects that something must be wrong.

Heat losses are but one way in which dollars fly out the window needlessly when electrical circuits are neglected. Frequent breakdowns are another. Men and machines stand around idle. Or, voltage drops reduce machine output. Lumped together, the damages the industrial plant suffers from antiquated, deficient wiring are often enormous. And authorities estimate that *nine out of ten industrial plants today are being penalized because of obsolete electric wiring!*

Outstanding characteristics of this Anaconda cable are: 1. Its remarkable stability. This has been demonstrated by tests as well as by use in the field. 2. The compound is highly resistant to moisture, acids and alkalies. 3. Low susceptibility to combustion and explosion. 4. Its heat-resisting characteristics permit large emergency overloads.

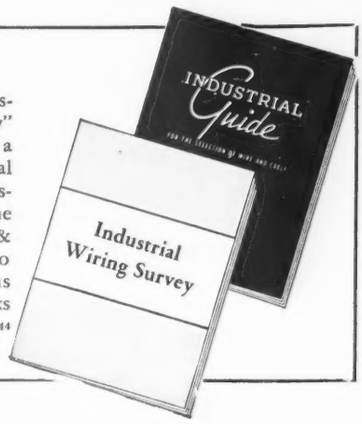
Write for data on Duracode

Safeguard your plant

A wiring survey will cost you nothing and may save you thousands of dollars. We offer here a complete plan for such a survey. The books shown at right give you everything you need to initiate a check-up of your plant's circuits. New, informative, they are being used by hundreds of manufacturers. Send for them today.

If you have a specific problem in mind, consult our Engineering Department. We will cooperate without obligation. Why not take advantage of the many important improvements in cable design pioneered by Anaconda Wire & Cable Co.? Let us tell you about them.

FREE! The "Industrial Wiring Survey" tells how to make a check-up of electrical circuits. The "Industrial Guide for the Selection of Wire & Cable" tells how to correct conditions found. Both books will be sent free. 37544



Cable Company

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ANACONDA
from mine to consumer

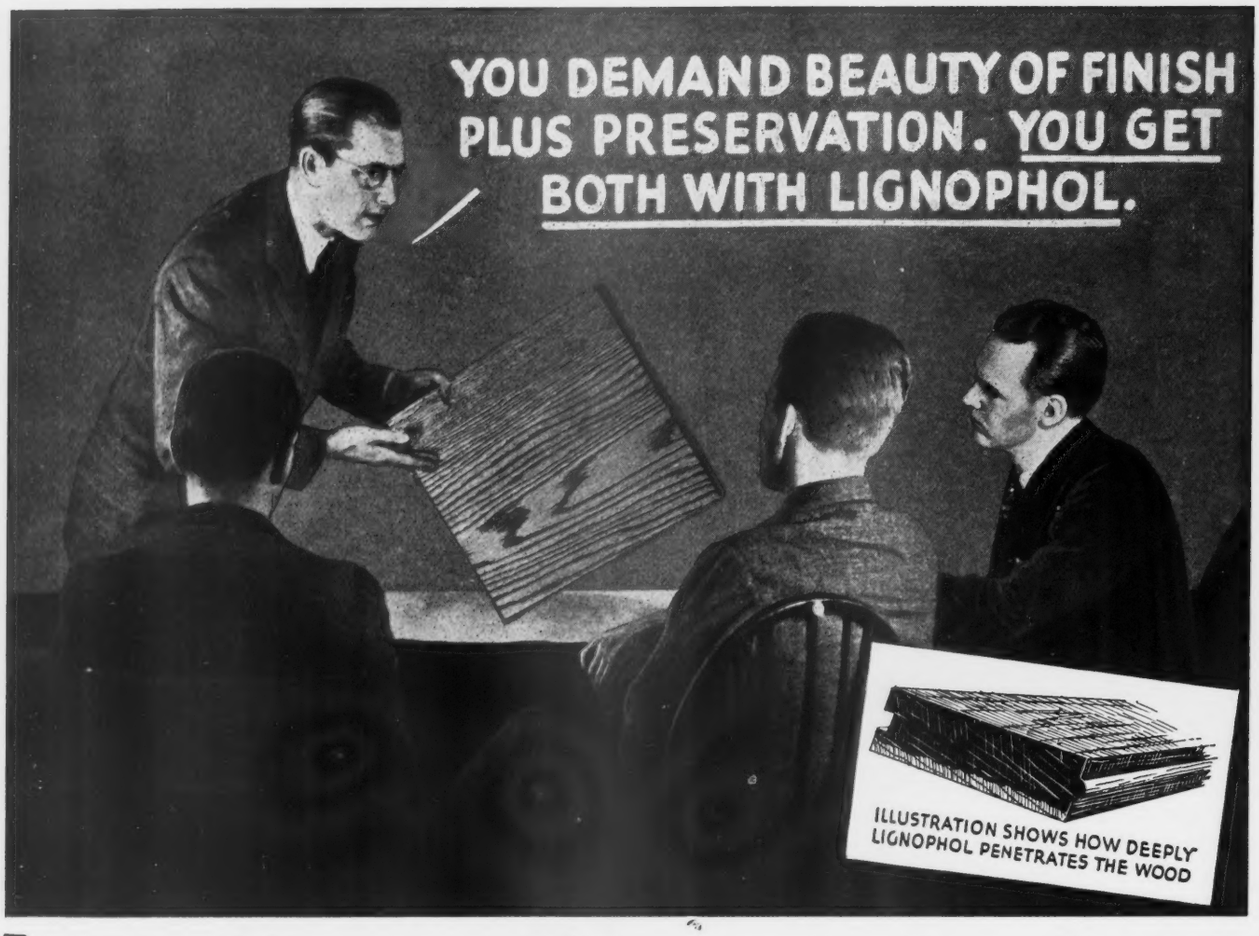
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ILLUSTRATION SHOWS HOW DEEPLY LIGNOPHOL PENETRATES THE WOOD

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Superintendents, architects and builders who have used LINGNOPHOL on wood floors will tell you that it not only provides a superior penetrating preservative, but also gives a durable, attractive finish for these floors in factories and buildings generally.

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Write Dept. F.M. 12 today for "on the job" proof of this tested SONNEBORN product. Full information and complete performance records will demonstrate why LIGNOPHOL should be your choice for wood floor preservation plus finish.

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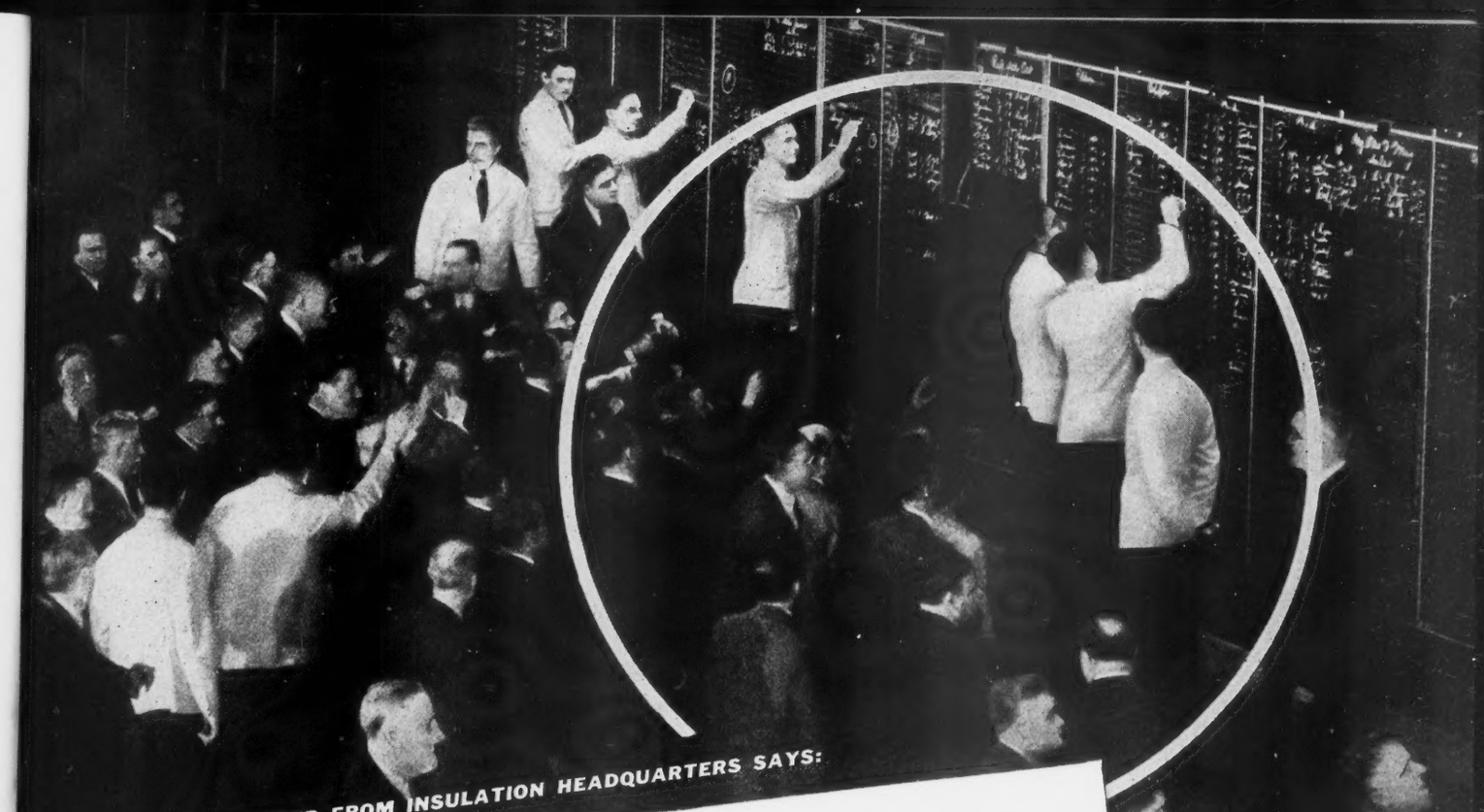


THE ENGINEER FROM INSULATION HEADQUARTERS SAYS:

"LIKE ALL STOCKS— ALL INSULATIONS DON'T PAY THE SAME DIVIDENDS!"

"SINCE insulations are purchased as an investment, the matter of dividends is of prime importance in their selection.

"As in the case of stocks, these insulation dividends are bound to vary. In fact, the cash returns in fuel savings promised by any given insulation are dependent upon three things . . . *kind, amount and application.*"

This statement—by the man from Insulation Headquarters—deserves the attention of every insulation buyer interested in securing the greatest return on his investment.

It is based on experience gained by Johns-Manville through some 75 years of research and practical field service. Experience which has shown that one . . . five . . . or ten different kinds of insulations cannot possibly meet with maximum efficiency and economy the requirements of *all* heated or refrigerated equipment on the market today.

This is a truth long recognized at Johns-Manville. The present line of J-M Insulations totals some *forty* different types . . . each designed for a specific insulating service . . . And all sharing in common a time-established record for superior performance and durability.

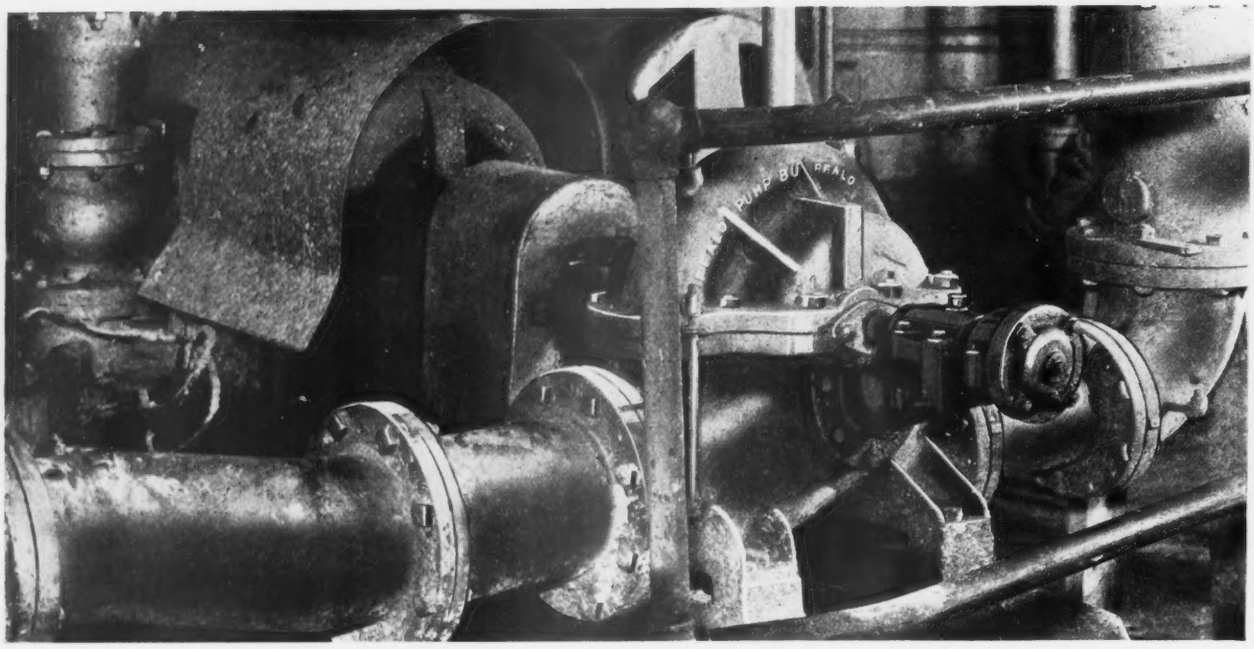
Hence, having a line of insulations so unusually complete, Johns-Manville is in a position to help you choose the type and thickness of insulation that will assure maximum cash dividends, over the longest period of time, on each insulating job in your plant.

For full details on all J-M Insulating Materials, ask for Catalog GI-6A. Johns-Manville, 22 E. 40th St., N.Y.C.

JM Johns-Manville INDUSTRIAL INSULATIONS

An insulating material for every temperature . . . for every service condition

18 YEARS CONTINUOUS SERVICE



"Buffalo" Double Suction Pump in a Sulphite Mill handling 1000 g.p.m. of white water against 105' head. (This is not the pump referred to in the letter below.)

that's PERFORMANCE!

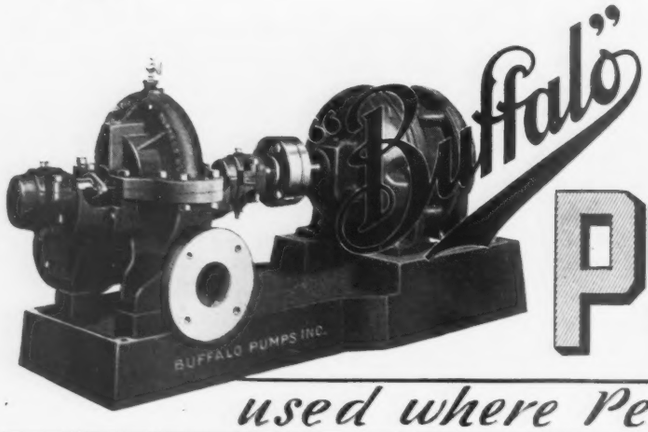
The following, taken from a letter to us from a Superintendent of Mines, tells another vivid story of "Buffalo" Pump performance.

> "I believe yours is one of the most economical pumps I have ever used and I have had thirty years experience pumping and have used many good pumps during this time.
>
> "I happen to know of one Buffalo Pump here in the field that has seen eighteen years service and it is pumping today."

"Buffalo" Pumps give that kind of performance because "Buffalo" engineers know pumping problems as well as efficient well-balanced pump design.

They build pumps to do specific jobs, rate them accurately, test them thoroughly under actual load conditions before those pumps ever leave the factory.

If you would like more information on these economical "Buffalo" Pumps, write—



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471 Broadway Buffalo, N. Y.

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PUMPS

used where Performance Counts

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Gilmer BELTS

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Send for your copy so you can start saving NOW

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L. H. GILMER COMPANY, Tacony, Philadelphia

THE OLDEST FIRM OF RUBBER FABRIC BELT SPECIALISTS

WESTINGHOUSE INDUSTRIAL LIGHTING IS BOTH

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Westinghouse 400-Watt Combination Mercury-Incandescent Unit with Safe-Change Hanger and Suspension Mounting Transformer.

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CONSIDER HIGH INTENSITY MERCURY

This relatively new form of industrial illumination is especially applicable in plants where a premium is placed on precision manufacturing. In Metal Working and Textile plants, for example, Westinghouse High Intensity Mercury lighting provides more abundant light; increases accuracy, reduces accidents, improves employe-morale. It is both *more efficient* and *more economical* than ordinary lighting systems . . . deserves important consideration in your 1938 modernization program.

A combination of High Intensity Mercury and Incandescent lighting can be applied with excellent results, wherever an approximation of daylight is desired for purposes of color discrimination, or discernment of fine detail.

For full details about High Intensity Mercury lighting, call your Westinghouse Jobber Lighting Specialist. No one is in a better position to advise you, because Westinghouse alone offers *complete* High Intensity Mercury equipment . . . reflectors, ballast equipment, lamps and accessories. Or write directly to Westinghouse Electric & Manufacturing Co., Lighting Division, Edgewater Park, Cleveland, Ohio.

for HEAVY INDUSTRIES *specify* MILLITE

Westinghouse Millite is especially designed for heavy-duty applications in high-bay areas . . . wherever lighting equipment is called on to endure severe service and to resist the deteriorating effects of corrosive vapors and infiltrated dirt. It is built for sustained lighting performance and easy maintenance under adverse conditions . . . in Steel Mills, Processing Plants, etc. Ask your local Westinghouse Jobber Lighting Specialist for the new Millite folder.

WHEN YOU THINK OF *Lighting* THINK OF

Westinghouse

OXWELD
WELDING BLOWPIPE
TYPE W-22

. . . *efficient for excess acetylene flame operations*

The Oxweld* W-22 is indeed a most convenient blowpipe for all welding operations requiring an excess acetylene flame, such as welding pipe or plate by the Lindeweld* process, or in hard-facing of wearing parts with Haynes Stellite* welding rod.

The W-22 operates on the low-pressure principle—acetylene is drawn into the mixing chamber at low pressure. This assures a soft, even welding flame.

The oxygen and acetylene valves are at the front end of the handle. The acetylene valve is conveniently adjusted by the thumb of the hand holding the blowpipe. Thus, high speeds are easily maintained.

For complete information about this unusual blowpipe, write to The Linde Air Products Company, Unit of Union Carbide and Carbon Corporation, New York and principal cities.

*Trade-Mark

Everything for Oxy-Acetylene Welding and Cutting

LINDE OXYGEN • PREST-O-LITE ACETYLENE • OXWELD APPARATUS AND SUPPLIES FROM UCC LINDE UNION CARBIDE

EFFICIENT...

Teeth, not tension. That's the performance secret of Morse Silent Chain Drives' greater efficiency. • Smooth, positive, even flow of power from motor to machine is assured with Morse Chain Drives. No slipping, no binding. Morse Chains' multiple teeth grip and turn with sure ease and efficiency. All your power is productive power with Morse Chain Drives! • They're better—yet Morse Chain Drives actually cost no more. Ask the Morse man in your territory, or write MORSE CHAIN COMPANY, ITHACA, N. Y. • *Division Borg-Warner Corp.*

MORSE POSITIVE *Silent* CHAIN DRIVES

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DECEMBER, 1937

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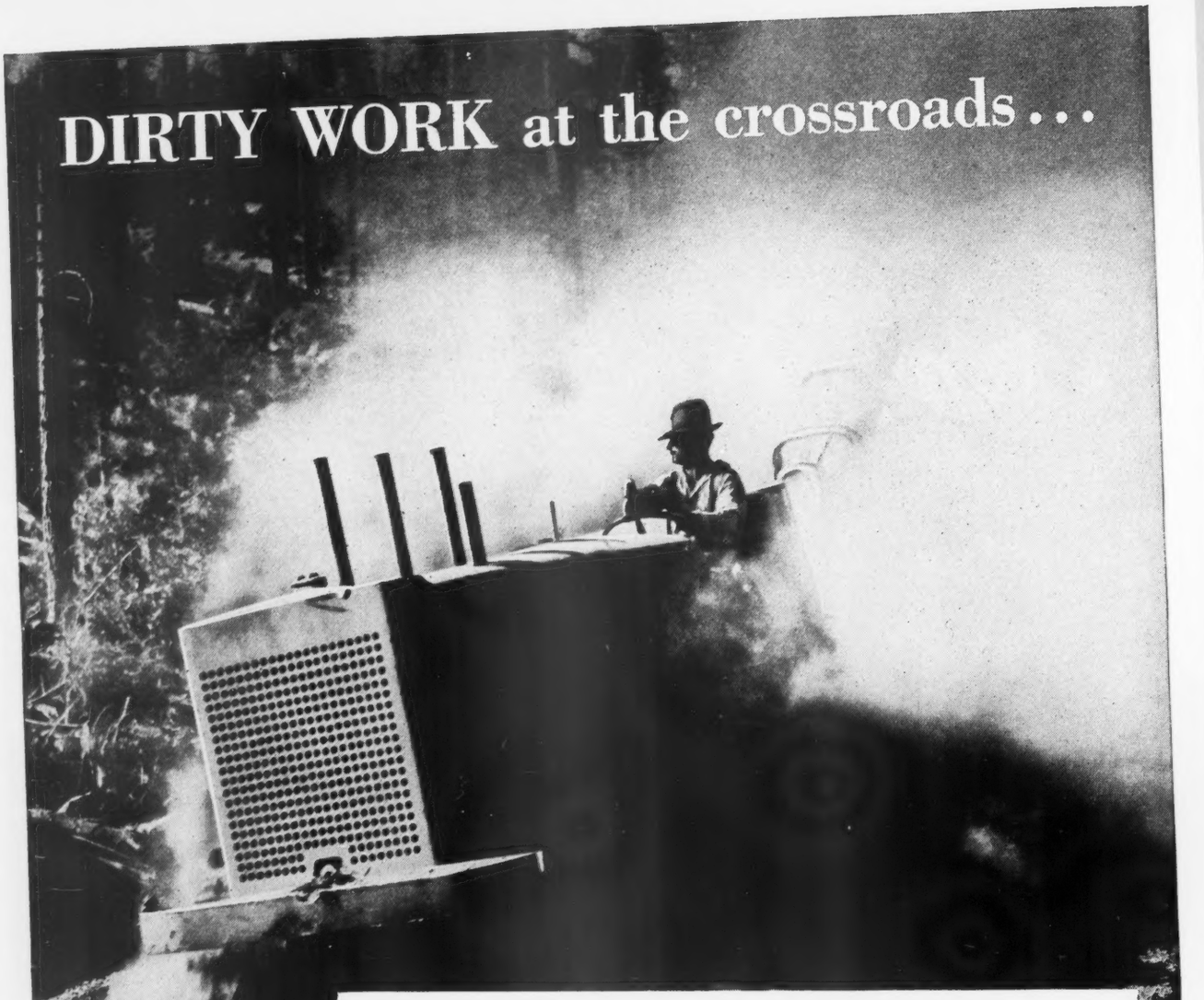
DIRTY WORK at the crossroads...



Any Dirty Work costs less when machines have N-D-Seal Bearings...lubricated for life...grease sealed in, dirt out

No bearing job is too tough, or dirty, for N-D-Seal Bearings. These self-sealed bearings are one of the latest proofs that important new departures in bearing design come from New Departure. Already more than nine million are in use. You must be interested in N-D-Seals if you build or use machines. Send for our Booklet D12.

Less Friction...Nothing Rolls Like A Ball

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New Departure • Division General Motors Corporation • Bristol, Connecticut

ALSO MAKERS OF THE LARGEST SELLING COASTER BRAKE FOR BICYCLES

Factory
Management and Maintenance
L. C. MORROW, EDITOR

Why We Protest the Wage and Hour Bill

WE PROTEST the Wage and Hour Bill now in the hands of Congress. It isn't that we disagree with the objective of a higher standard of living for the "submerged third." It isn't that we want to see people work more than 40 hours a week. It isn't that we want to see any one get less than 40 cents an hour.

We'd like to see everyone have good fat yearly incomes. We don't want them to work too long or too hard to get their incomes. And we should like for those incomes to buy as much of goods and services as such incomes will buy now.

But we know that incomes depend upon production. We know that in the long run the individual, as well as an industry, receives for his services amounts in direct proportion to his contributions to production. We know that as prices go up with increased costs, incomes purchase less.

Further, we are convinced that an attempt to legislate purchasing power—and that's what the Wages and Hours Bill is—is an attempt to put the cart before the horse. Purchasing power exists because of production. Production is not created by purchasing power.

Also, there are valid reasons why wages and hours should vary by industries and geographically. No five-man board can understand all of the variables, even if assisted by a multiplicity of local advisory boards. Confusion, political maneuvering, business uncertainty, would result.

Finally, an entering wedge would be provided for control by government of all wages and hours of work. That would be bad because of the probability of being forced into price and production control in order to retain the purchasing power of wages. And right there free enterprise would go out the window. Wage regulation for industry would eventually require offsetting wage legislation or else cash subsidies for agriculture. After that, what of salaried workers? What of wage and salary differentials? What of the end-result of an income-price situation on a higher level than today's, but with no greater purchasing advantage for anyone?

These almost certain results are not easily apparent. A bill to provide minimum wages and maximum hours for about 2,000,000 low-paid workers looks innocent. But, if industrial history means anything, even those low-paid workers will not benefit in the long run. This we attempt to show in the article, "The Folly of Wage Regulation," that follows. In the article we submit figures showing the history of wage regulation. Those figures constitute our reason for protesting the Wages and Hours Bill.

The Folly of Wage Regulation

If industrial history means anything, even the 2,000,000 low-paid workers whom regulation purports to help will not benefit in the long run

LEWIS K. URQUHART
Associate Editor

WAGE AND HOUR regulation will not work. It has been tried time and again. The record shows that it decreases employment opportunity, man-hours worked, annual incomes, and purchasing power. It has precisely the opposite effect that its proponents claim for it.

Discussion of such regulation at this moment—this article goes to press November 13—is necessarily complicated by the fact that the Congress meets two days later to consider the Fair Labor Standards Act passed July 31 by the Senate. Any one of a number of things may therefore happen during the two weeks that will elapse before this December issue of *Factory* is placed in its readers' hands.

Three Possibilities

Consider, for instance, the possibility that the Bill will be passed by the House in the early days of the session. In that case this article may appear to have lost some of its timeliness, although it should be no less useful for showing what this industrial nation of ours has been let in for.

Again, and let us hope that this is not entirely wishful thinking, there is the possibility that the Bill may be defeated before this issue gets into the hands of its readers. In *that* case this article would be equally useful the next time a rash of wage and hour regulation broke out, as it inevitably would.

Still another possibility exists. The Bill may be given the long and serious consideration it deserves. That is certainly a consummation devoutly to be hoped for. And in *that* case this attempt to point out the folly of wage and hour regulation may have had time to reach some of the places where it will do the most good.

First, let us see what the Bill proposes, always keeping in mind that almost anything may eventually come out of the hopper, with a perfectly good chance that it will be something far more drastic. For our analysis we may turn to any one of a number of summaries that have been made; this one is the U. S. Chamber of Commerce's. The bill provides for:

1. Minimum wages not to exceed 40 cents an hour, except for overtime.

2. Maximum hours not to be less than 40 hours a week.

3. Application by a federal Board of such minimum wages and maximum hours to enterprises producing, handling or transporting goods that enter into interstate commerce, or are sold intrastate in substantial competition with goods moving in interstate commerce.

4. Exercise of discretion by Board, subject to conditions set forth—

a. In determining the specific minimum wages and maximum hours to be applicable to particular occupations, industries, or subdivisions thereof, and to particular groups of enterprises and employments classified according to localities, size of community, number of employees, nature and volume of goods produced, and other circumstances considered by the Board as differentiating; and to special classes of workers such as learners, apprentices, physically or mentally handicapped persons, and others justifying special treatment;

b. In determining conditions under which overtime would be permitted with or without payment of higher wage rates for hours worked in excess of applicable maximum.

5. Prohibition of shipment in interstate commerce of goods on which work has been performed by employees receiving lower wages or being utilized for longer hours than those prescribed by the Board.

6. Prohibition against employment of any person in violation of applicable wage and hour standards prescribed by the Board.

How was the revised bill received? This is what the *New York Times*, which is in general favorably disposed toward Mr. Roosevelt and his policies, thought of it:

"There is grave danger that the

Wage earners live by the year, not by the hour. Hence the futility of gabbling about wage *rates*. It's annual incomes and real wages—purchasing power—that count. Wage rates *can* be raised by fiat. Real wages *can't*. All the evidence points to the fact that wage regulation lessens the chance to work, cuts down number of hours worked, decreases annual incomes and purchasing power. The law may give, but the high cost of living is sure to take it away

wages and hours measure will be passed in a sentimental haze, under the dominance of the idea that only those who vote for it are friends of labor, and that all who vote against it are either callous or 'reactionary' or prompted by selfish motives.

"Yet the opponents of the bill in its present form may prove in the long run to be the real friends of labor. For labor cannot prosper any more than any other element of the population if business is disorganized by sudden increases of production costs, by sudden shifts in the existing relations between production costs in different geographical sections or on competing products, by disorganization in our foreign trade, and by the uncertainties of bureaucratic control.

"No doubt the good intentions of the sponsors of the Wages and Hours Bill, their humanitarian impulses, are of the highest. But their economic reasoning, and the particular methods which they have chosen to achieve their goal, are more than questionable.

"Consider the report filed by the House Labor Committee in submitting its revision of the Wages and Hours Bill as passed by the Senate. It declares the wage of $800 which would be made by a laborer working for 50 weeks a year at 40 cents an hour for a week of 40 hours to be indisputably the minimum required for an American standard of living. There is no need to dispute this. If what is being discussed is what minimum wage is desirable, the figure would have to be raised considerably higher. But there is reason to question whether the minimum living standards of a country can be fixed at any desired level by passing a law.

"The naïveté of the committee's reasoning is most apparent in its remark that as the Labor Standards Board under the act is permitted to determine minimum wages only in those industries where 'substandard' labor conditions exist, 'the high type of American business man whose wages and hours are in line with the thought of the President on this social principle' need have no fears.

"The implication here is that wages are fixed at the whim of the individual employer and depend upon his personal generosity rather than upon the broad economic conditions prevailing in this country. One would have to assume that automobile manufacturers, paying an average rate of 88 cents an hour in the spring of this year, were nearly twice as patriotic as textile manufacturers paying an average only of 49 cents an hour, while tire manufacturers, paying 94 cents an hour, were more than twice as fine fellows as tobacco manufacturers paying only 43 cents."

No less hard to understand than this naïvety on the part of the House Labor Committee is the almost complete indifference of what we usually think of as Big Industry to what is going on right under its nose. Many industrialists went to Washington, to be sure, and put themselves on record as opposing the Bill in principle. But most of them seemed to take comfort in the thought that their wage scales were well above the 40-cent minimum and therefore their employees would not be affected in any way.

How Many Affected?

Obvious question is: Just how many wage earners *would* be affected? Nobody knows, for the simple reason that the only complete records we have for hourly earnings are *averages*. We know from the Department of Labor statistics that average hourly earnings in the knit goods industry, say, were 47.7 cents an hour in February of this year. But we do *not* know how many wage earners in that industry were getting less than the average and how many were getting more. Presumably some were getting less than 40 cents an hour. But how many?

Somehow the notion seems to have been bruited about that only 2,000,000 wage earners would be reached by a 40-cent minimum. I wonder if this comforting thought may not be traced back to what must have been

McGraw-Hill Field Photo Service

No Congress can legislate prosperity. As a nation and as wage earners, we can have only what we produce. The charts on the facing page tell *that* story, first for all the manufacturing industries, second for the cotton textile industry. The only way to increase the wage earner's share of the national wages—not what he makes by the hour, but what he earns by the year—is to increase his productivity. When we *do* increase his productivity, nothing has ever prevented the wage earner from benefiting in proportion to the individual contribution he makes to the increase

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little more than a shrewd guess made by Dr. Isador Lubin, Commissioner of Labor Statistics of the Department of Labor, in his testimony at the joint hearings before the Senate Committee on Education and Labor and the House Committee on Labor. Asked by Senator La Follette whether he agreed with the estimates of another witness as to the number of wage earners who would be affected by the minimums and maximums that would be established, Dr. Lubin made the following ment:

"I won't say that I disagree, but I think this is true, that putting it in terms of industry, the industries that will be affected to any large extent are relatively few in number. I have here a table showing the industries in which at the moment the average hourly earnings are 44.9 cents or less, and there are only eleven manufacturing and three non-manufacturing . . . You have the sawmill industry, cotton goods, silk and rayon, corsets, men's furnishings, shirts and collars, confectionery, cigars and cigarettes, cottonseed, fertilizers and one or two others. Those would be the industries where the big proportion of the workers would be affected.

"In other industries, it would be scattered firms here and there. Frankly, I would say that the number of workers directly affected would not be in excess of 2,000,000."

If we accept this estimate, however, we fail to take wage differentials into account. Wage differentials are so essential a part of our whole industrial system that even the NRA codes did not attempt to disturb them. "They will be found," pointed out the National Industrial Conference Board in a recent report, "wherever there are comparisons between workers in the same occupations, different occupations, different industries, and different localities."

Kick Like a Steer

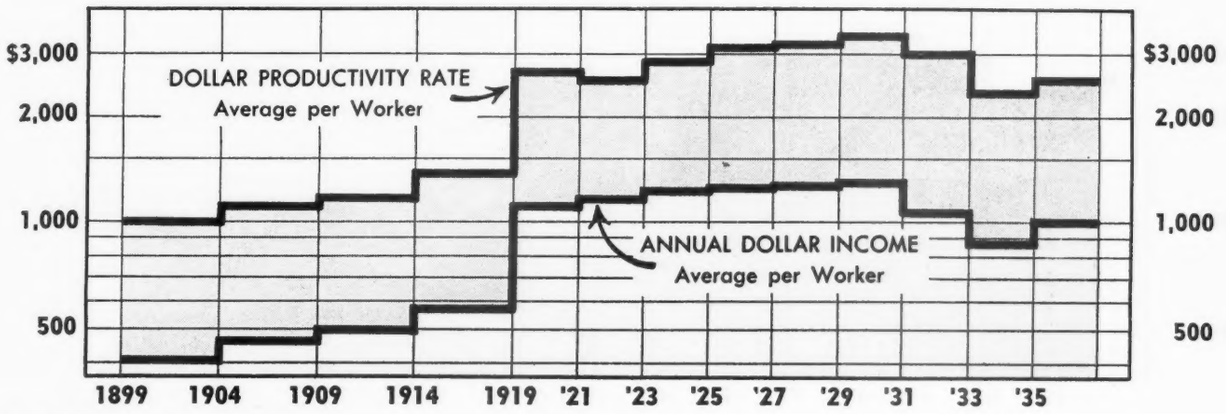
Take the simplest case of all—that of the moderately skilled employee who gets, say, 50 cents an hour. What will his reaction be when common laborers who were getting, say, 30 cents, are boosted up to 40? Isn't he going to kick like a steer? Isn't he going to do everything he can to get 10 cents more and so maintain the differential to which he has been accustomed? And when he gets his, what about the man who used to get 65 cents? Won't *he* insist on that extra 15 cents that has always stamped him as a somewhat better man than his fellows?

Plainly, industry is going to be subjected to constant pressure on the part of better paid employees for more money. It is to be noted in passing that Dr. Lubin guessed that 2,000,000 wage earners would be *directly* affected. Was he holding out on the Committee to the extent of several millions more who would be *indirectly* affected?

We may likewise speculate here momentarily on the effect that all this would have on the farmer. It seems to be rather generally assumed that he won't be affected. But nothing could be farther from the truth. For what happens when the hired man finds out he can get more money for less work in the neighboring sawmill or cannery? Is he going to be contented? Not much. The farmer will simply have to pay more for his labor or do without the hired man. And if he pays the hired man

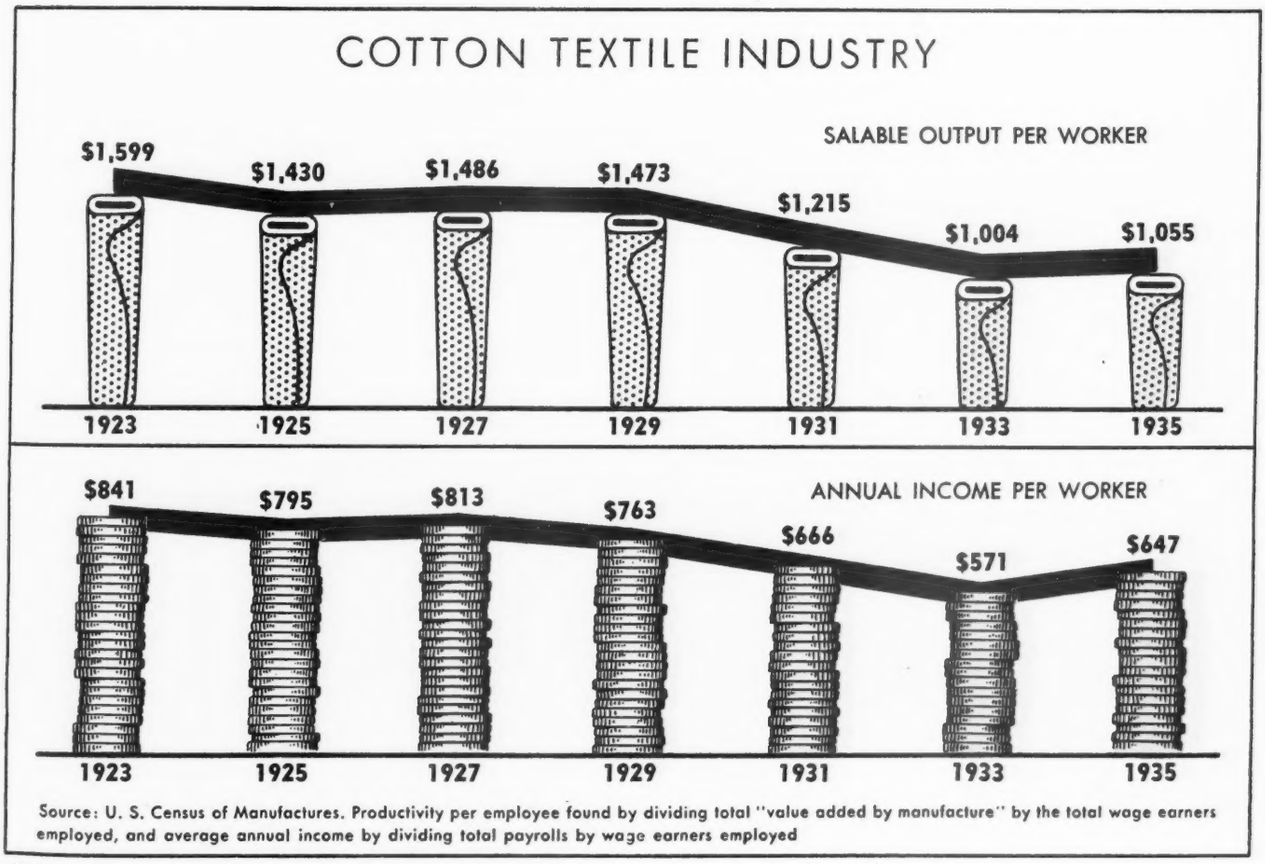
Output Determines Income

FIGURE 1. AVERAGE ANNUAL PRODUCTIVE RATE PER WORKER AND ANNUAL AVERAGE INCOME PER WORKER — ALL MANUFACTURING



Source: U. S. Census of Manufactures

FIGURE 2. ANNUAL INCOME FOLLOWS THE TREND OF THE ANNUAL PRODUCTIVITY RATE

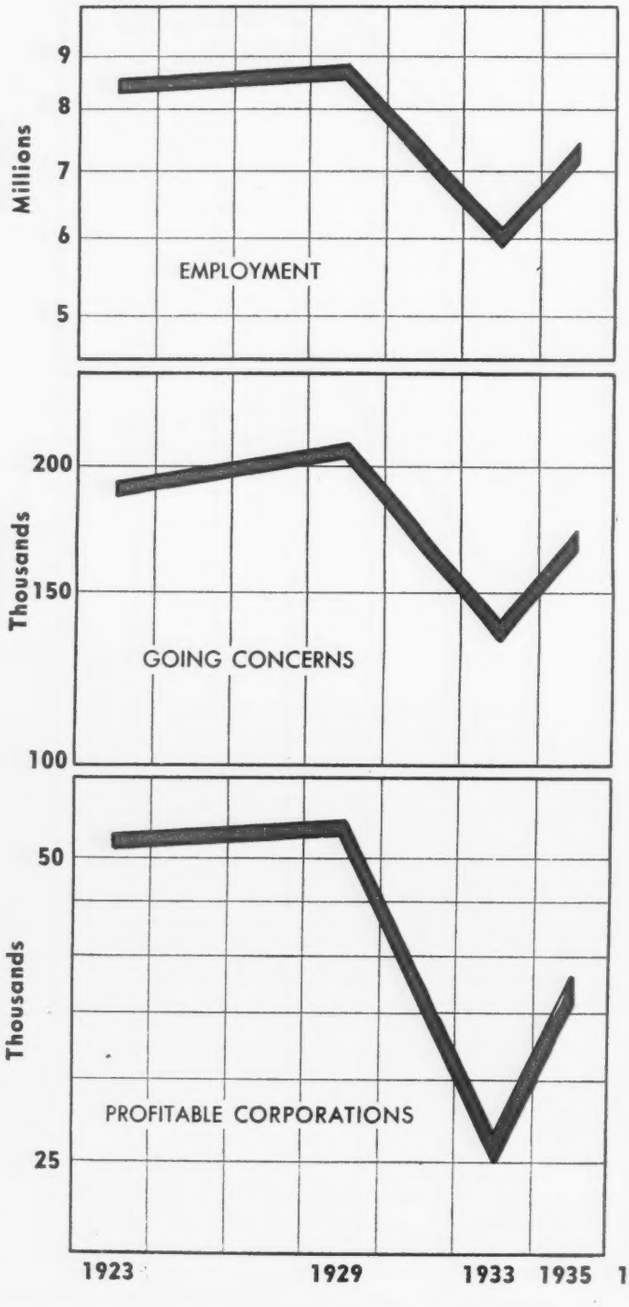


Source: U. S. Census of Manufactures. Productivity per employee found by dividing total "value added by manufacture" by the total wage earners employed, and average annual income by dividing total payrolls by wage earners employed

Charts on this and succeeding pages taken from Labor's Road to Plenty, by Allen W. Rucker, L. C. Page & Co., Publishers, Boston

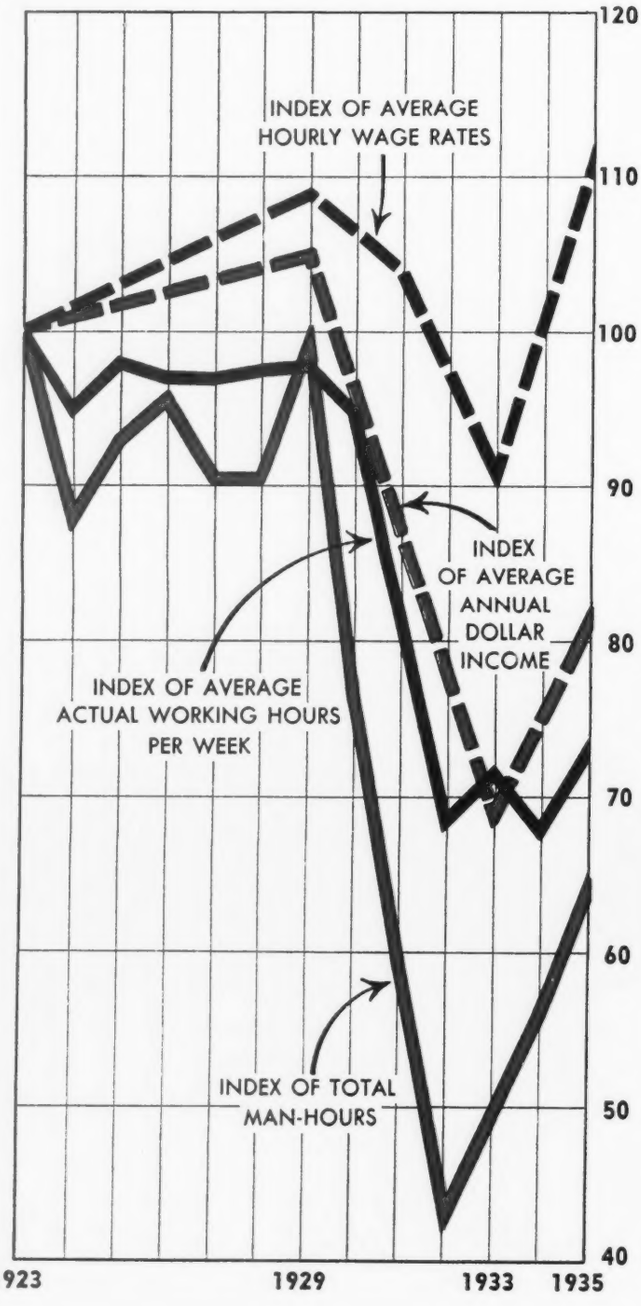
Hours, Jobs, and Incomes

FIGURE 3. EMPLOYMENT OPPORTUNITY, GOING CONCERNS, AND PROFITABLE CORPORATIONS



Sources: Employment and going concerns, U. S. Census of Manufactures; profitable manufacturing corporations, U. S. Treasury Statistics of Income

FIGURE 4. WEEKLY WORKING HOURS, TOTAL MAN-HOURS, WAGE RATES, AND DOLLAR INCOME



Sources: Working hours per week and total man-hours, National Industrial Conference Board; wage rates, Department of Labor Index; annual income, U. S. Census of Manufactures

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more, he must get more for what he sells. More serious still is what happens when industry and farm prices get out of line. That we shall come to a little later.

What will be the effect of wage and hour regulation on industry's costs? One might have expected that manufacturers would go to Washington armed with facts and figures. Curiously enough, they did nothing of the kind. Almost to a man, they contented themselves with generalities when questioned as to wage rates and production costs in their particular industries.

The Case of Southern Pine

A leader in the opposition to wage and hour regulation, the Southern Pine Industry Committee has published some revealing figures which, although coming from a not unbiased source, are worth examining because they are indicative of what might be expected to happen to costs of doing business in other low-wage manufacturing industries:

"Large Southern Pine mills, according to a cost survey made by this committee for the year 1936, paid 39 per cent of the total dollar of cost to labor; 21 per cent went for stumpage and timber supplies, and 13 per cent for operating materials and supplies. Thus, nearly 75 per cent of the dollar of cost is spent providing the means to production. That leaves only 25 per cent to take care of depreciation and overhead, including selling, the rapidly mounting tax burden, insurance, salaries, and other general expense. In small mills, with little or no capital overhead, responsible for one-half the total output in our industry, these conditions are even more exaggerated.

"Price is a vicarious factor, with peaks and valleys that make profit margins uncertain and unattractive to investors. In a year of recovery, like 1936, the large mills cited above netted an f.o.b. mill average price of only $25.33 per M feet against an average cost per mill of $22.81 per M feet. Thus the return on sales in the first really prosperous year since 1930 was barely 10 per cent, and production in the industry is still 30 per cent below 1929 levels.

"This wage and hour bill would so greatly affect labor, overhead, and supplies that few large mills could produce for less than $10 per M increase in their cost. To net a conservative 10 per cent, sales price would have to be better than $36 per M, the highest ever reached except for a brief period in the 1920 boom. Such a ridiculous price could not be obtained on competitive markets, and mills would be forced to run at a loss until bankrupted, or else shut down and discharge all their employees."

It is almost axiomatic that a section like the South, distant from the large centers of trade, with its own peculiar racial, social, and economic problems must operate on lower wage scales. The *real* earnings of Southern wage earners are at least equal to the earnings of industrial employees in other parts of the country. The profits of Southern industries are certainly no greater than in other sections, and in no part of the country are profits so large and so universally earned that industry can absorb the increased costs of wage regulation and not pass them on to the consumer.

Equal dollar wages, in other words, would be sure to put hundreds of smaller Southern industries out of business, thereby throwing thousands of wage earners out of employment, presumably on relief.

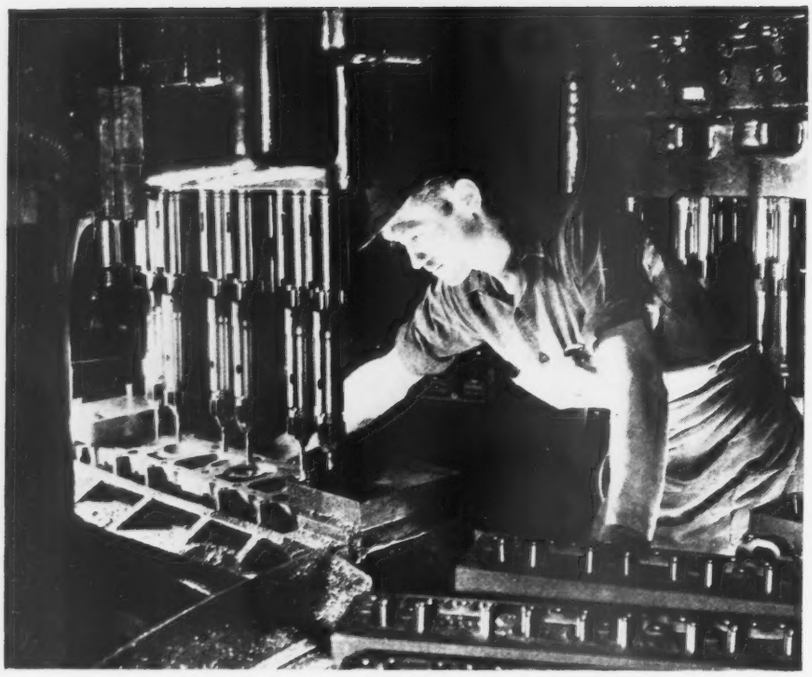
It has been argued that this essential maintenance of the North-South differential has been sufficiently safeguarded in the present bill. That is why a flat 40-cent minimum has not been set. That is why it has been left within the discretion of the Board to set wage standards up to 40 cents an hour.

It has been further argued that no Board would be foolish enough to walk into a small community, Southern or otherwise, and put it completely out of business through the simple medium of raising wages to a point where the small local industry would have to shut its doors. And yet our experience with other boards leaves us with no assurance that this one will do anything else but strive to secure for labor the maximum "benefits" afforded under the law.

One point seems perfectly plain. And that is the tremendous burden that will be placed on the Board;

This small Southern lumber mill is typical of thousands of smaller concerns whose very existence is threatened by arbitrary increases in wage rates. Unfortunately, every time one of them goes out of business, there are just that many fewer total chances to work. How closely the number of jobs parallels the number of going concerns and profitable corporations is illustrated in one of the facing charts

International Harvester photograph, courtesy The Southern Lumber Journal



Must industry once more go through all the agony and futility of "spreading the work"? Shortening the work week merely divides available man-hours of work, does nothing to increase output. And if industrial history means anything, the wage earner fares best in those industries that focus attention on increasing his productivity. Compare, on the facing chart, the employment record of, say, the automotive industry where it takes only 21 wage earners to produce $100,000 of "value added to manufacture" with that of the cotton textile industry where it takes 64 wage earners to produce the same amount

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not only do we have in it the threat of autocratic control of industry and labor—not only must we look forward to the spectacle of five $10,000-a-year men dictating the destinies of some 12,000,000 wage earners, the spending of some $10,000,000,000 of annual wages, and the ultimate fates of 175,000 manufacturing establishments. We have also to fear the very magnitude of the task that will be theirs. The size of the job is simply beyond comprehension.

Some Vital Questions

So much for the pending wage bill. Much of what has been said concerning it must remain sheer speculation. There is no telling what the final draft will look like. We have no way of knowing how many wage earners would be affected, how much it would raise the cost of finished goods, how many marginal firms it would put out of business, what it would do to the cost of living. Would the working of the law throw people out of jobs who previously got less than the minimum because they were incapable of earning that much? Would the law raise "tariff" barriers between sections and disorganize the low-wage industries?

Those are some of the questions to which answers are not quickly and easily, if at all, obtainable. But if we cannot know the precise effects of this particular piece of wage and hour legislation, there need be no question in our minds concerning the unsoundness of wage and hour regulation in general. Arbitrary price, wage, and hour regulation has been going on in this country for the past fifteen years, finding expression in such forms of legislation as the Railway Act of 1921, various state minimum wage laws, NRA, the Guffey Coal Act, the Walsh-Healy Act, and now the Fair Labor Standards Act.

Fortunately, as Allen W. Rucker* has pointed out, we have the experience of a number of great industries that have been dominated either by governmental or union regulation of wages and hours. Their experience is noted in the records of the Bureau of the Census, the Treasury Department, and other federal fact-finding agencies. It is an experience that cannot be ignored.

A Poor Case for Regulation

There is no lack of data showing what has actually happened to labor where wage and hour regulation has been tried in periods of both prosperity and depression. These data are available in the form of national averages of wage rates and incomes, employment and man-hours. They are available for individual industries. They make out a very poor case for regulation.

Mr. Rucker's reasoning is very briefly as follows:

1. Employment opportunity and man-hours per annum are determined by the physical quantities of goods produced and distributed, and neither can be increased in any way other than by an increase in marketable volume.

2. The marketable volume of physical values depends upon the degree of price balance prevailing between industrial goods and the incomes of basic consumers.

3. Further inflation of hourly wage rates must still further distort price relationships and aggravate the deficiency of employment opportunity and wealth distribution now existing.

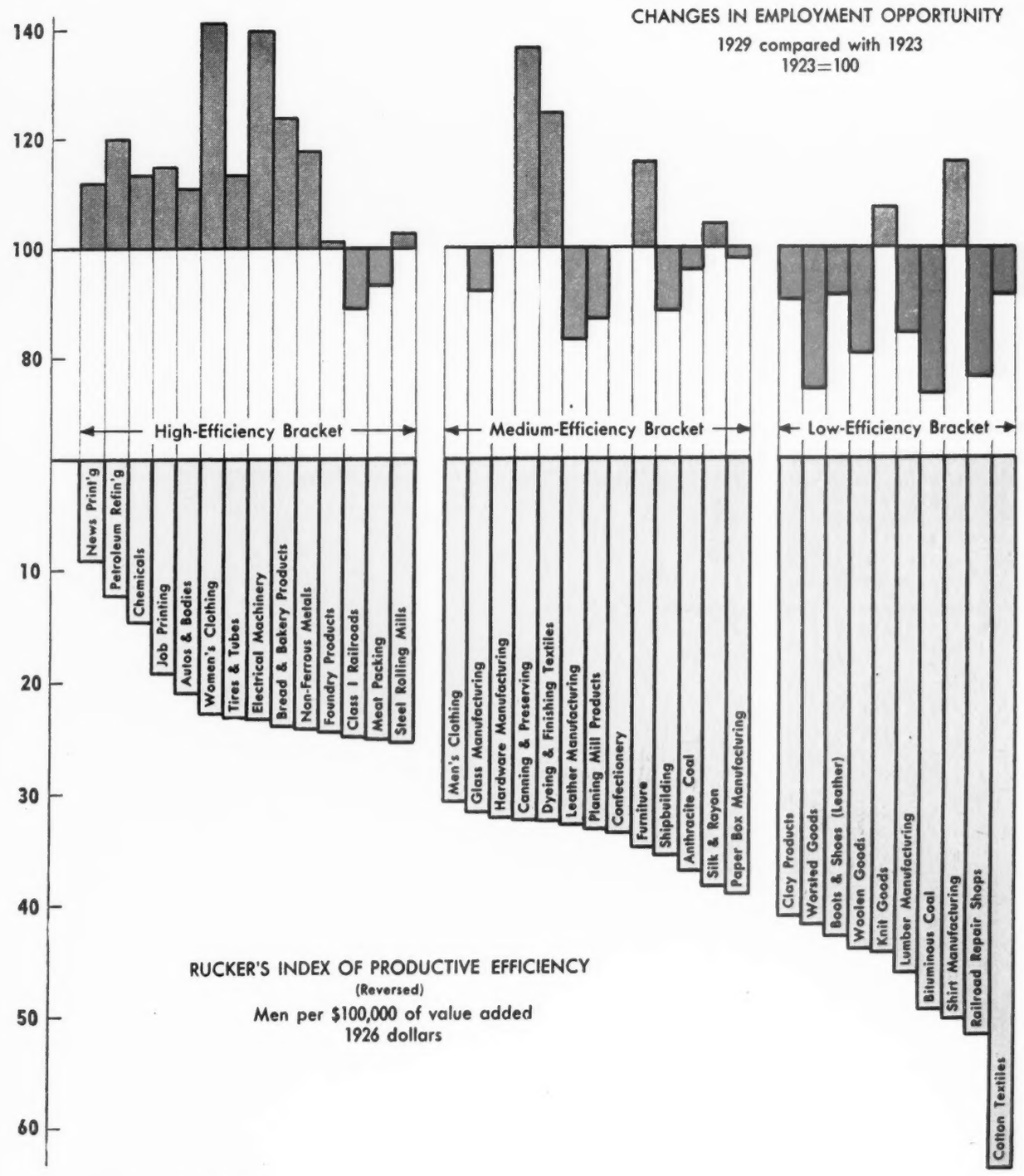
In the first place, we can, individually and collectively, have only what we produce. Only by producing more can we have more. That goes for the nation. It goes for wage earners. Figure 1 shows how it works out in all industry. Note how closely the annual income parallels the annual productivity rate per wage earner.

Wage *rates*, in short, can be raised by legislative fiat, *annual incomes* never. The American system pays off in proportion to productivity. And the system works in

*Labor's Road to Plenty, The Return to the American System of Productivity, by Allen W. Rucker, L. C. Page & Co., Publishers, Boston, $2.50.

Jobs and Machines

FIGURE 5. CHANGES IN EMPLOYMENT OPPORTUNITY IN HIGH-EFFICIENCY, MEDIUM-EFFICIENCY, AND LOW-EFFICIENCY INDUSTRIES



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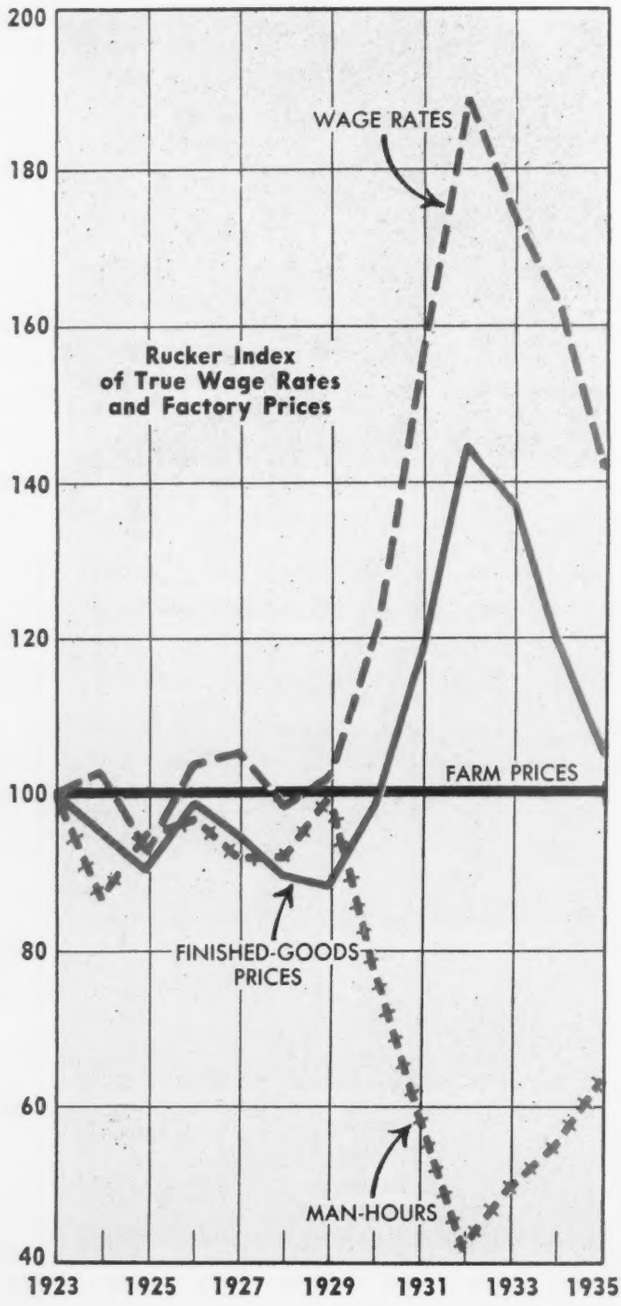
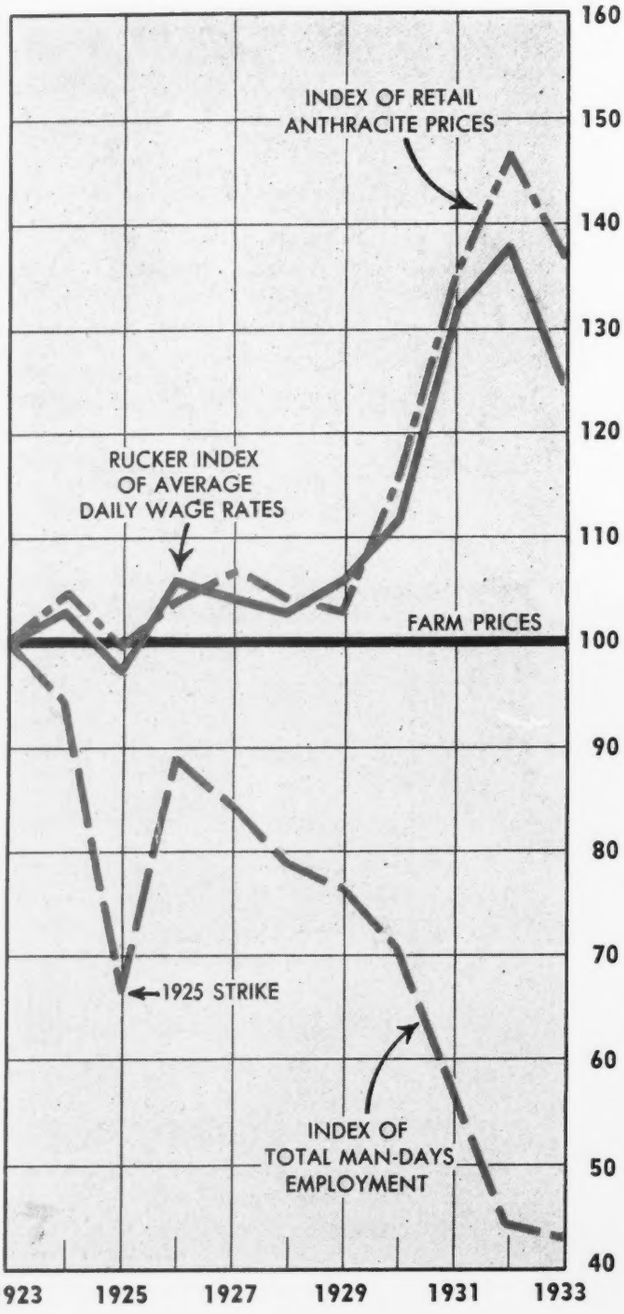
Wages, Hours, and Prices

FIGURE 6. WAGE RATES, MAN-HOURS, AND FINISHED-GOODS PRICES



Sources: Wage rates, Department of Labor Index; man-hours, National Industrial Conference Board; price data from Bureau of Labor Statistics, U. S. Department of Labor

FIGURE 7. ANTHRACITE WAGE RATES, RETAIL PRICES, AND MAN-DAYS



Sources: Wage rates and man-days, U. S. Bureau of Mines, Department of Interior; price data from Bureau of Labor Statistics, U. S. Department of Labor

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good times and bad. Neither alleged industrial oppression nor union aggression can influence it. Average annual income per wage earner has for the past 30 years been strictly proportionate to the values that the average wage earner helps to produce, despite any and all attempts to legislate prosperity.

Note, too, that nothing has ever prevented the wage earner from getting his share whenever his productivity has been increased. That is one beauty of the system.

Figure 2 shows the same picture for the cotton textile industry. Note that annual income slid off from $841 to $763 during the generally prosperous years between 1923 and 1929, while output was falling from $1,599 to $1,473.

These end-results, both in cotton textiles and all manufacturing, serve to illustrate the utter futility of prattling about wage rates. It should be plain by this time that wage rates in themselves are not worth a hoot. It's annual incomes that count.

Now the total chances to work are very definitely limited by the number of going concerns, and there is a definite connection between the number of manufacturing corporations earning a profit, the number of going factories, and the total factory employment opportunity.

This connection is visualized in Figure 3 which shows number of jobs in millions, and number of profitable corporations and going concerns in thousands. It proves that, by providing conditions that encourage capital and management to increase the number of going concerns and enable them to increase the number of profitable corporations, we shall automatically enlarge the employment opportunity for industrial wage earners.

Examination of the available data makes it immediately apparent that increases in wage rates are not followed by proportionate increases in annual incomes, nor does rigid maintenance of wage rates serve to sustain annual incomes, unless the productivity rate of the wage earner so warrants.

Likewise, shortening the work week, whether by conditions or compulsion, does not expand the total employment opportunity, but is usually accompanied by a reduction in the total jobs available.

Figure 4 shows what has happened over a period of prosperity and depression. Average annual incomes have never been increased in proportion to the rise in wage rates. And in good times and bad a decline in employment opportunity and total man-hours worked accompanies a shortening of the work week, whereas employment increases with a lengthening of the work week.

In Figure 4 we have seen the unfortunate results to labor in large-scale tinkering with wages and hours. These results lead proponents of such tinkering to two plausible assumptions.

How wage rates influence industrial prices—and what happens to factory output when wage rates rise above farm prices—is shown for all manufacturing in one of the facing charts. The other provides the same picture in the fully unionized anthracite coal mining industry where, if higher wage rates and shorter working hours really do increase labor's income and employment opportunity, the greatest benefits should have accrued. Actually, the successful efforts of the union to enforce arbitrary wage rates cut man-days 25 per cent, even in a period like 1923-29

McGraw-Hill Field Photo Service

Labor's Fair Share

One is that labor's purchasing power declines because management fails to distribute to wage earners a fair share of values produced; the other, that the decline in the number of total chances to work is traceable to increased productivity per worker through the use of highly improved machinery.

The first of these assumptions is easily shot full of holes. The records show that the higher the proportion of "value added by manufacture," the lower the purchasing

power of industry's employees as a group. For instance, the canning industry in 1933 paid out in wages 26.4 per cent of the "value added"; the shoe industry paid out 53.3 per cent. Yet employment in the canning industry increased 16.2 per cent, purchasing power 11.4 per cent, over 1923 levels. At the same time, employment in shoe factories dropped 59.6 per cent, purchasing power 20.2 per cent. Certainly there is no evidence here that employment and purchasing power suffer because management does not distribute to wage earners a fair share of what they produce.

Machines Create Jobs

The other assumption is, in effect, that machines create unemployment. The fact is, they make jobs. Figure 5 is just one way of proving this point. In it 37 industries are rated according to the number of wage earners required to produce $100,000 of "value added."

Note that of the 14 industries in the high-efficiency bracket—the industries that make the greatest use of the machine—all but 2 showed increases in employment through the years 1923 to 1929, a period when there was every opportunity for taking full advantage of technological development and in which any tendency toward unemployment from that cause should certainly have been accentuated.

Continuing our examination of Figure 5, we find that of 13 industries in the medium-efficiency bracket, 4 showed employment gains, 6 showed losses, 2 no appreciable changes. But when we come to look at the 10 industries in the low-efficiency bracket, only 2 showed employment gains in a period of prosperity, while 8 sustained losses.

For instance, it takes only 21 wage earners to produce $100,000 of "value added" in the automotive industries. Certainly increasing use of the machine was made throughout the period 1923-1929. Yet during those years employment increased 10.5 per cent, annual average income 25.7 per cent. In the cotton textile industry, on the other hand, where it takes 64 wage earners to turn out $100,000 of "value added," employment dropped off 9.9 per cent during the same period of general prosperity, while average income was reduced 10.2 per cent.

Again the record contains cold comfort for those who believe that increased productivity tends to create unemployment. Actually, the record denies that theory. And, even more important, the facts show that labor fares best in those industries that focus attention on the need to squeeze every possible benefit from technological development.

Final exhibits are Figures 6 and 7. They illustrate what happens to factory output and consequently to factory employment and payrolls when industry is unable, because of artificial wage rates, to keep its prices in balance with general prices.

Figure 6 shows how total man-hours of work declined almost exactly proportionate to the extent that finished goods prices rose above farm prices. Figure 7 provides the same picture for the 100 per cent unionized anthracite coal mining industry, where, if wage and hour regulation really benefits the wage earner, its benefits should be most apparent. Instead the record shows that increased wage rates resulted in fewer man-days of work. Note that, even in a period of prosperity, 1923 to 1929, man-days declined 23.5 per cent.

That is the inevitable outcome of wage and hour regulation. A 40-cent minimum wage rate will increase the national average hourly wage rate. And any increase in the average wage rate automatically diminishes the total man-hours of work available to labor and nullifies attempts to increase the total jobs.

Based on the record, true friends of the American wage earner must oppose further attempts to regulate hours and wages. If industrial history means anything, they can hardly do otherwise.

Underwood & Underwood

How are you going to keep the hired man down on the farm after he learns he can get more money for less work in the neighboring sawmill or cannery? The farmer will have to pay higher wages or do without the hired man, get more for what he sells, pay more for what he buys. Figure 6 shows how, as factory wage rates rise above the farm price level, total man-hours of work provided by the manufacturing industries decline. Prosperity depends upon a balanced relationship between industry and farm prices

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Congress Needs YOUR Guidance....NOW

An Opportunity for the Million Readers of McGraw-Hill Publications to Help Business Recovery

TODAY, everybody sees that private industry *alone* can lead the march back to prosperous times. Business leaders, labor leaders, legislative leaders, and now the National Administration, all agree that the leadership must pass from government to private enterprise. As spokesman for the Administration, Secretary Morgenthau has said:

"The basic need today is to foster the full application of the driving force of private capital. We want to see capital go into the productive channels of private industry. We want to see private business expand."

So do we all. Nothing can take the place of expanding business. The business man needs it to meet his expenses and earn a profit. The investor needs it to put his capital to productive use. More than anyone else, the workman needs it for a steady job at regular wages. And the government needs it to get the revenues required to carry on. Everyone needs better business; there is no other way forward. But if business is to resume its leadership, government must revise its policies to make the shift possible.

Everyone who knows anything about federal taxes knows that the present system is not sound; it has been made even less so by some of the experiments of the last few years. However good those experiments may be in theory, their practical result is to frighten business men and investors from taking the risks that are necessary for business revival. As Secretary Morgenthau puts it:

"We realize that our tax laws are too complicated; we want to make them less so. We realize that there are inequalities; we want to eliminate as many of them as we can."

With this encouragement from the Administration, Congress now must get at the job. Many see the need, but it is Congress that must do something about it. What it does will depend on how it interprets the views of the people. *The time has come for the people to tell their Congress what they want.*

At no time since 1929 have business people — employers and employees — had so promising an opportunity to impress their views and their needs on the Washington government. The iron is hot; now is the time to strike!

Specifically, these three needs are urgent:

First — *Repeal the undistributed earnings tax.* As a producer of revenue it is discredited. Its chief effect has been to obstruct recovery and curtail employment by holding back the normal plant improvements by industry. Such improvements make for higher efficiency, *the only means by which consumers can get more*

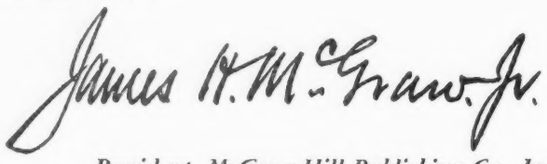
for their money, without loss of income as producers. Altogether, the undistributed earnings tax obstructs development, destroys employment, and encourages unsound financial practices. It should be repealed.

Second—*Repeal or amend the capital gains tax.* As it now stands, the investor who sells securities when prices are rising must give the government a large slice of his profit; but when he sells on a falling market he must eat his own losses. That is a one-sided, unfair proposition. It is heads-the-government-wins, tails-you-lose. It discourages the sound investment practice required by stable business. It should be repealed or amended to allow adequate deductions for losses.

Third—*Reduce the excessive personal surtaxes.* These high taxes were designed to reach for 75 per cent of the rich man's income. Whatever may be said for that objective in theory, it doesn't work in practice. It *appears* to "soak the rich" but in fact it is a blow in the air. For the rich can escape by hoarding their wealth in tax-exempt securities—municipal and government bonds rather than industrial securities. It is the latter that create productive enterprise, with orders for business and jobs for workers. So the effort to exact excessive taxes from the rich drives funds out of industrial employment and into government bonds; at the same time it dries up the source of the desired taxes. Excessive surtaxes are a good example of losing all by over-reaching; they should be amended to encourage enterprise and increase revenues.

The America of today is possessed of the same driving force that created it. All it asks is a chance to resume its progress. In the early days of our national development, government paid huge bounties to encourage private construction of the railroads. Today industry asks no bounties; it asks only a chance to invest in national progress the surplus wealth that it has itself created. It is willing to meet the increased obligations of social progress and to pay its share of the governmental costs, but it asks relief from the shackles of restrictive and confiscatory taxation. It is ready to resume its interrupted march toward restored prosperity if only Congress will loosen the bonds that now confine it. Only Congress can effect that release. It can do so only by revising restrictive taxation. And only the American people can prevail upon Congress to meet that appeal *and to meet it NOW.*

Congress needs *YOUR* guidance. Will you give it *NOW?*



President, McGraw-Hill Publishing Co., Inc.

If private capital and business initiative are to take a leading role in recovery—then it is the obligation of the business and technical press to study ways and means by which this is possible; to keep business and industry currently informed; to mobilize opinion and to make that opinion felt and understood by the government, which has the power to obstruct or to encourage business and industrial progress. The McGraw-Hill Publications recognize that obligation. We are seeking in this editorial effort to provide an avenue through which our one million readers—America's business and industrial leaders—may indicate to the Congress the need to change the tax system so that industry can move forward more surely and rapidly.

USE THESE CARDS...*NOW!*

To encourage Congress to revise taxes NOW

To secure extra copies of this editorial

To get a comprehensive analysis of taxes

To encourage Congress to act now along the lines of this editorial, send in one of the cards below—now. Studies have shown that an average of 4 persons read each copy of this publication—so four cards are here provided—one for each reader.

Extra copies of this editorial are available for you—at cost—should you desire to put this into the hands of your associates, employees or friends. You may order these on the card below, too.

Business Week is publishing in one of its December issues a comprehensive analysis of the tax situation. You may secure a free copy of this analysis by checking and mailing the card below.

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The Variable Budget in Management by Exception

AUTHOR

FRED V. GARDNER

Industrial Consultant, Milwaukee

In Two Parts — Part Two

The author was formerly with the General Electric Company, Schenectady, and the A. O. Smith Corporation of Milwaukee. Many of the exhibits shown throughout this section follow the plan used by the A. O. Smith Corporation. The flexible budget as used by the General Electric Company was described by Mr. Gardner in the February and March, 1934, issues

THIRTY-SECOND IN THE SERIES OF

FACTORY MANAGEMENT and MAINTENANCE

PLANT OPERATION LIBRARY

III. Forecasting and Control

IN THE FIRST part of this treatise (*Factory*, November, 1937) I presented the advantages of the variable budget as an interpretation of management. I contended that the variable budget is:

1. A factual interpretation which moves with changing conditions as expressed by volume or load.

2. An analysis simple enough to be readily understood by all types of supervision and yet sensitive enough to furnish management with a usable working tool.

3. A set-up that provides running controls by exception.

In order to support this contention I presented the application of the principles of the variable budget to the expense or burden control of a large company having several disconnected, diversified units operating under every type of manufacturing hazard. (See Exhibit VIII.) I am convinced that if the principles of the variable budget work under these conditions they will work in any manufacturing enterprise.

Now I shall carry this problem to a new field, that of forecasting and the resulting control which is necessary to make the forecasting positive. Let us face this problem from a critical angle, for there is still some skepticism on the part of many executives as to the value of forecasting in the manufacturing organization. This skepticism is usually expressed as follows:

1. "I cannot forecast my operations in the units by which I control my output," or

2. "I cannot depend upon the prognostications of the selling organization," or

3. "Management upsets my forecast without consideration."

The answer to these questions and to the many variations of them can be summed up as follows:

Forecasting is the process of looking ahead for a reasonable period of time, one day, one month, one year, or longer. It is a problem of setting down in expressive terms *general* conditions as they might be expected to happen.

Whenever the day comes that these predictions are met 100 per cent, time after time, the business world will no longer need managers, for business will have set itself in a groove and will need no guiding.

Meeting the Exceptions

Once a plan is set, the problem is one of meeting *not the things that happen as the budget says, but in meeting the things that deviate from the budget either in actual or expected happening.*

The reasons why forecasting is not used more widely are:

1. It is a human weakness not to want to face the facts because they point out one's personal troubles and because they present problems which one is willing to forget hoping they will take care of themselves before they actually arrive.

2. We try to be too exacting regarding the problems of forecasting.

Few of us will admit the first con-

EXHIBIT VIII

BUDGET - - - - AUGUST, 1937

Date Issued, July 26, 1937

GROSS SALES, COST OF SALES, MARGINS & PROFIT

	Plant A	Plant B	Plant C	Plant D	Plant E	Plant F	Plant G	Total
Gross Sales	1,600,000	1,400,000	180,000	240,000	100,000	19,000	120,000	3,659,000
Standard Costs	1,380,000	1,142,000	105,300	199,200	79,800	50,000	75,000	3,031,000
Std.Gross Margin	220,000	258,000	74,700	40,800	20,200	31,000*	45,000	627,700
Add (or Subtract) Over- (or Under-) Absorbed Burden	7,000	95,000*	42,000*	16,000	1,000	1,000	---	112,000*
Mat'l. Price Adj.	45,000	70,000	---	---	---	---	---	115,000
Scrap	12,000	25,000	---	---	---	---	---	37,000
Actual Gross Margin	284,000	258,000	32,700	56,800	21,200	30,000*	45,000	667,700
Less Sell. & Adm.	32,000	20,000	20,000	25,000	---	---	---	97,000
Net Profit from Operations	252,000	238,000	12,700	31,800	21,200	30,000*	45,000	570,700
Productive Labor Base	130,000	105,000	12,500	40,000	10,000	9,000	6,000	312,500

(*) Indicates Loss

EXHIBIT IX

Divisional Manager
Industrial Engineer

PLANT D
DAILY STATEMENT
(All figures are fictitious)

Date August 4, 1937
Date Issued August 5 3:00 P.M.

	This Date	Accumulated Mo. to Date
Normal Operating Expenses	$ 1 500	$ 5 000
Group I Special Expenses	15	100
Group II " "	150	1 000
Group III " "	300	1 800
Group IV " "	400	1 400
Group V " "	135	918
Total Expenses in Department	2 500	10 218
Other Budgeted Expenses	---	1 582
	2 500	11 800
Tools	400	2 000
Depreciation	200	750
Taxes	75	250
Insurance		200
Distributive	300	700
Other Charges	225	300
Total All Expenses	3 700	16 000
Productive Labor	1 000	7 000
% Expense to Productive Labor	370%	230%
Budget Realization	91%	94%
Burden Absorbed in Cost	3 000	15 000
Unabsorbed Burden	700*	1 000*
Total All Expenses	3 700	16 000
PROFIT AND LOSS ANALYSIS		
Standard Value Production	10 000	60 000
Standard Costs	8 000	47 000
Standard Profit	2 000	13 000
Over- or Under-Absorbed Burden	700*	1 000*
Gross Manufacturing Profit	1 300	12 000
Selling and Administrative	1 000	3 000
Other Charges	200	1 200
Total Sales and Administrative	1 200	4 200
Net Profit or Loss*	100	7 800
Forecast		6 000

*Credits, Deductions, or Over Budget

tention, so we shall not discuss it further. However, I suggest that you make a personal critical appraisal of this possibility and satisfy yourself that it is not at the bottom of your forecasting difficulties if you have any.

In regard to the second problem, let us face a few facts. When you as a factory executive say, "How can I forecast? I don't know what will be produced. Neither does the sales department," you avoid an issue. Through evasion, you make your problems more difficult. In many cases you state a temporary truth, but you evade the facts. As long as you take this attitude the sales department does nothing to improve its technique of forecasting.

A manufacturing problem is one of output. This output is expressed in units indicating volume. Although it is nice to know the several combinations that constitute volume such as sizes, grades, quantities, the most important thing is to start with *an over-all expression of whether output will increase or decrease when related to what we are doing at the moment.*

From a Creep to a Walk

We must be willing to realize that in forecasting manufacturing activities, we must creep before walking. Creeping is the art of analyzing over-all differences in general terms and at the same time placing an obligation on the sales organization which later can be compared with actual accomplishments. Only time is necessary to refine and develop the technique for detailed efficiency once these principles are established.

In the company in which we demonstrated the control of expense, a monthly Profit and Loss forecast is prepared (Exhibit VIII). The following rule is observed: On the twenty-fifth of each month three forecasts are prepared, one for each of the next three months. Since the same procedure was followed in prior months, the results are bringing up to date the forecasts for two months and adding a new one. By this method there is obtained a fairly accurate estimate for the month soon to start and a rough

EXHIBIT X

DAILY ACCUMULATIVE PRODUCTION PROFIT AND LOSS STATEMENT FOR AUGUST 4, 1937-ISSUED 8/10/37
(All figures are fictitious)

	Plant A	Plant B	Plant C	Plant D	Plant E	Plant F	Plant G	Total	Forecast	R%
1. Sales Value of Prod.	150,000	300,000	15,000	60,000	---	2,000	20,000	547,000		
Interworks	50,000	---	---	---	10,000	8,000	---	68,000		
TOTAL 1	200,000	300,000	15,000	60,000	10,000	10,000	20,000	615,000	693,300	89.5
2. Standard Costs										
Material	125,000	165,000	7,500	25,000	7,000	500	10,000	340,000		
Labor	20,000	25,000	500	7,000	1,000	7,000	---	60,500		
Burden	40,000	60,000	3,000	15,000	2,000	3,500	---	123,500		
TOTAL 2	185,000	250,000	11,000	47,000	10,000	11,000	10,000	524,000	570,000	92.0
3. Std. Gross Margin 1 & 2	15,000	50,000	4,000	13,000	---	1,000*	10,000	91,000	123,300	74.0
* Over or Under Abs. Bur.	3,500	20,000*	10,000*	1,000*	500	1,000*	---	28,000*	21,500*	
Material Price Adj.	6,000	10,000	---	---	---	---	---	16,000	22,000	
Other Adjustments	2,000	5,000	---	---	---	4,000*	---	3,000	7,000	
4. Actual Gross Margin	26,500	45,000	6,000*	12,000	500	6,000*	10,000	82,000	130,800	62.7
5. Selling & Administrative	1,000	1,300	1,500	3,000	---	---	---	6,800	18,300	
	2,500	2,900	1,000	1,200	---	---	---	7,600		
6. Net P. or L. Before Taxes	23,000	40,800	6,500*	7,800	500	6,000*	10,000	67,600	112,500	60.0
7. FORECAST	48,600	45,000	2,400	6,000	4,000	6,000*	12,500	112,500		
Analysis of Over or Under Absorbed Burden										
Budgeted Mfg. Expense	24,000	40,000	7,500	11,800	1,000	2,200	---	86,500	93,000	107.5
Over or Under Budget	4,000	22,000	2,000	---	100	600	---	28,700	30,000	104.5
Total Mfg.Exp.Budgeted	28,000	62,000	9,500	11,800	1,100	2,800	---	115,200	123,000	106.8
Tools	2,500	5,000	---	2,000	---	---	---	9,500	8,000	
Own Depreciation	2,200	10,000	1,400	750	200	350	---	14,900	15,000	
Taxes	200	100	1,100	250	50	100	---	1,800	2,500	
Insurance	1,000	1,000	500	200	50	70	---	2,820	4,000	
Distributive	1,500	1,200	500	700	100	200	---	4,200	6,000	
Other	1,100	700	---	300	---	980	---	3,080	3,000	
Total Burden	36,500	80,000	13,000	16,000	1,500	4,500	---	151,500	161.500	106.8
Earned Burden	40,000	60,000	3,000	15,000	2,000	3,500	---	123,500	140,000	
Total Over- or Under* Absorbed Burden	3,500	20,000*	10,000*	1,000*	500	1,000*	---	28,000*	21,500*	
Productive Dollars	20,000	25,000	500	7,000	1,000	7,000	---	60,500	70,000	86.5

R%-Realization % to Forecast

*Loss

idea of what is to come in the future.

In Exhibit VIII the August forecast is expressed by plants and by the various elements of sale and cost. Since the manufacturing division uses productive labor and the sales organization sales as expressions of volume, the preliminary estimate of business which comes from the sales organization is usually expressed in over-all units of output. This is converted to the sales dollar and then to the productive labor dollar.

The standard costs shown in the forecasts are material, labor, and burden which, under our variable method, have been predetermined as factors and expressed as so many units of fixed and variable costs. Knowing the productive labor, the calculation of these factors in the standard cost dollar is

Table III. Breakdown of Sales and Costs

Dollars in Thousands

	May		June		July		August	
	Forecast	Actual	Forecast	Actual	Forecast	Actual	Forecast	Actual
Sales	$5,400	$5,500	$3,500	$3,520	$2,200	$2,400	$2,000*	$2,300*
Costs (std.) ..	4,500	4,600	3,100	2,985	1,900	2,000	1,750	2,000*

* Through 20th.

only a mechanical process requiring in this case less than two hours of effort by a cost clerk.

The other items of cost are the expressions of expected realizations under the standard costs. In other words, in preparing this forecast, management is definitely admitting that they do not expect to meet standard costs under the general conditions of the forecast output.

To illustrate this point, in Plant A it is expected that because of the sales volume we shall over-absorb our burden by $7,000, be $45,000 under our material standard, and get a credit for scrap of $12,000. This will raise the standard gross margin from $220,000 to $284,000.

Honesty the Best Policy

In Plant C, it is expected that we shall fail to absorb our burden in our standard costs by $42,000 and thus reduce the gross margin by that amount. This is a predetermined expression of the difficulties expected by management in their day-by-day control and by this type of honesty they are better able to meet and face the situation in advance, constantly keeping in mind the desirability of improving these expected deviations.

There is not enough space to present a series of forecasts on a detail of Exhibit VIII, but in order to point out further potentialities in this type of work, I show parts of the forecasts of sales for May, June, and July in Table III. Certain significant information can be gained from this presentation by the comparison of predicted and actual volumes and performances.

In the same breakdown by plants many more deviations would be shown because the units are smaller and are not compensated by one another.

When the August estimate was made, preliminary estimates also were made for September and October. The September estimate expected sales of $3,636,950; the October estimate, $3,765,400. Compared to August, September presents no problems (except of shifts by lines or plants), and October means setting plans for further increases.

I am inclined to believe that in some industries forecasts should be prepared for the high and low periods of the year so that management has before it constantly an expression of the expected minimum and maximum range of output, labor requirements, and inventory.

Though the art of forecasting presents many advantages, and over a period of time will in itself improve the operating efficiencies in most organizations, the real results come from following the forecast, measuring actual results against it, and pointing out to the responsible executive the deviations from it.

In the company in question this profit and loss follow-up is a daily report. I question the advisability of such a procedure in the average plant; weekly reports should suffice. The important thing to remember is that, whether daily or weekly, the basic problems are the same.

Exhibit IX shows the daily Profit and Loss Report covering Plant D, and Exhibit X shows a similar report covering all the plants. The figure shown as Item 7, Exhibit VI (last month) and the figure shown as Item 7 in Exhibit IX are the same—$10,218. Glancing down the figures shown on Exhibit IX, we find the sales, cost of sales, and a detail of the variations from normal costs.

Above all, notice the promptness involved in the issue of this report. The report is for August 4 and was issued at 3:30 p. m. the next day. In each division similar profit and loss reports are prepared.

Four Days Later

In some of the other divisions certain conditions such as payroll and set-up make it impossible to get the information on the following day, but in all cases the information is available and issued in total never later than the fourth working day. Exhibit X bears this out, for it shows that the report for August 4 was available to management on August 10 (the fourth working day after).

Exhibit X shows the elements of costs. At the bottom of the profit and loss statement are found the details of the over- or under-absorbed burden involved in the statement. This was intimately controlled by the method covered last month in Exhibits I to VII.

No doubt you have been saying to yourself as we proceeded, "The cost of this must be fabulous." Exhibit XI shows in detail all the information that must be compiled in order to support the profit and loss figures shown in Exhibit IX. This information also is the basis for the complete budgetary control shown in Exhibits V to VII inclusive.

There is no great amount of effort involved over and above the normal requirements of compiling payroll and cost information. Since this exhibit is self-explanatory we shall not discuss its details. I merely want to call attention to its utter simplicity. Any increase in cost, due to its preparation, should be nominal. The important thing to remember is that, by reducing the lag in control to a reasonable time, savings can be made. The following facts must be taken into consideration:

1. A good share of the work done by the factory clerical organization, especially in the cost department, is the compilation of reports requested by executives in the dim past. They are still prepared because no question is raised as to their present value. Usually they are obsolete and no longer serve a real purpose.

2. Over 50 per cent of the work performed by the cost department in the average organization is the presentation of historical information of a standard type because the preparation is part of the general routine required in costing. Much of this information is out of date, ill designed for specific problems, and does not fire the imagination of key people.

3. Most of the information is too detailed, and when supported by working papers is too involved for running comparison so necessary in our present set-up.

Reports Must Be Current

I believe that the problem of development along statistical lines is as important as along any other line and that statistics of costs and cost factors must be overhauled and reviewed constantly. By the conscientious elimination of weak and obsolete reports and by the application of the principle that the reports being issued must be current, the average organization should be able to carry out all that was done with the organization whose exhibits are presented here. That organization has not added personnel since this type of control was developed.

One of the secrets of this type of control is the ingenuity in designing the set-up so that it takes full advantage of information that must be prepared for other purposes. For example, the control of indirect or nonproductive labor and the base on which burden is controlled (direct or productive labor), is available in the payroll (which must be collected currently and which if properly collected will more than cover all the statistical requirements for control). The ability to size up these possibilities and the use resulting therefrom are important factors in current-day management.

EXHIBIT XI

Date _____

Name of Part _____ Part No. _____

Routing No. 3 Run In _____

Material _____ Rough Size _____ Weight _____

Supersedes Part No. _____ Weight Per Unit _____

Dept. No.	Oper. No.	Operation	No. of men	Mach. Type and No.	Set Up Time	Piece work Operator	Rate Helpers	Labor Cost per 100 Pcs.	Prod. per hour	Std. Labor Cost per 100 Pcs.
193	70	Drill block and size (10) steps	2						9.5	
		Operator	1							5.70
		Helper	1							5.50
193	75	Straighten	1						9.5	11.20
		Operator								
		Helper								

ASSIGNMENT AND TIME CHANGE NOTICE — August 4, 1937

Operation Description: Straighten — Operation No. 75

Assembly No. — Part No. P340962395-7 — Dept. No. 193

Machine No. 35 — Quantity 100 — Charge Account S-200 — Shift 1

No.	Clock No.	Hours Piece Work	Hours Day Work	Rate Day Rate	Rate Standard	Standard Amount	Actual Amount Paid
1	15450	80	0	700		1120	700
2	15452	80	0	600			600
3							
4							
5							
6							

Assignment Finished — Pieces Finished 1120 — 1300

ASSIGNMENT AND TIME CHANGE NOTICE — August 4, 1937

Straighten — 75 — P340962395-7 — 193 — 35 — 100 — S-200 — 1

No.	Actual Amount Paid
1	1 80
2	4 32
3	3 13
4	3 20
5	
6	

Assignment Finished — Pieces Finished 12 45

Foreman

MATERIAL TO BE USED FOR

Supply — August 4,1937 — S-55-193

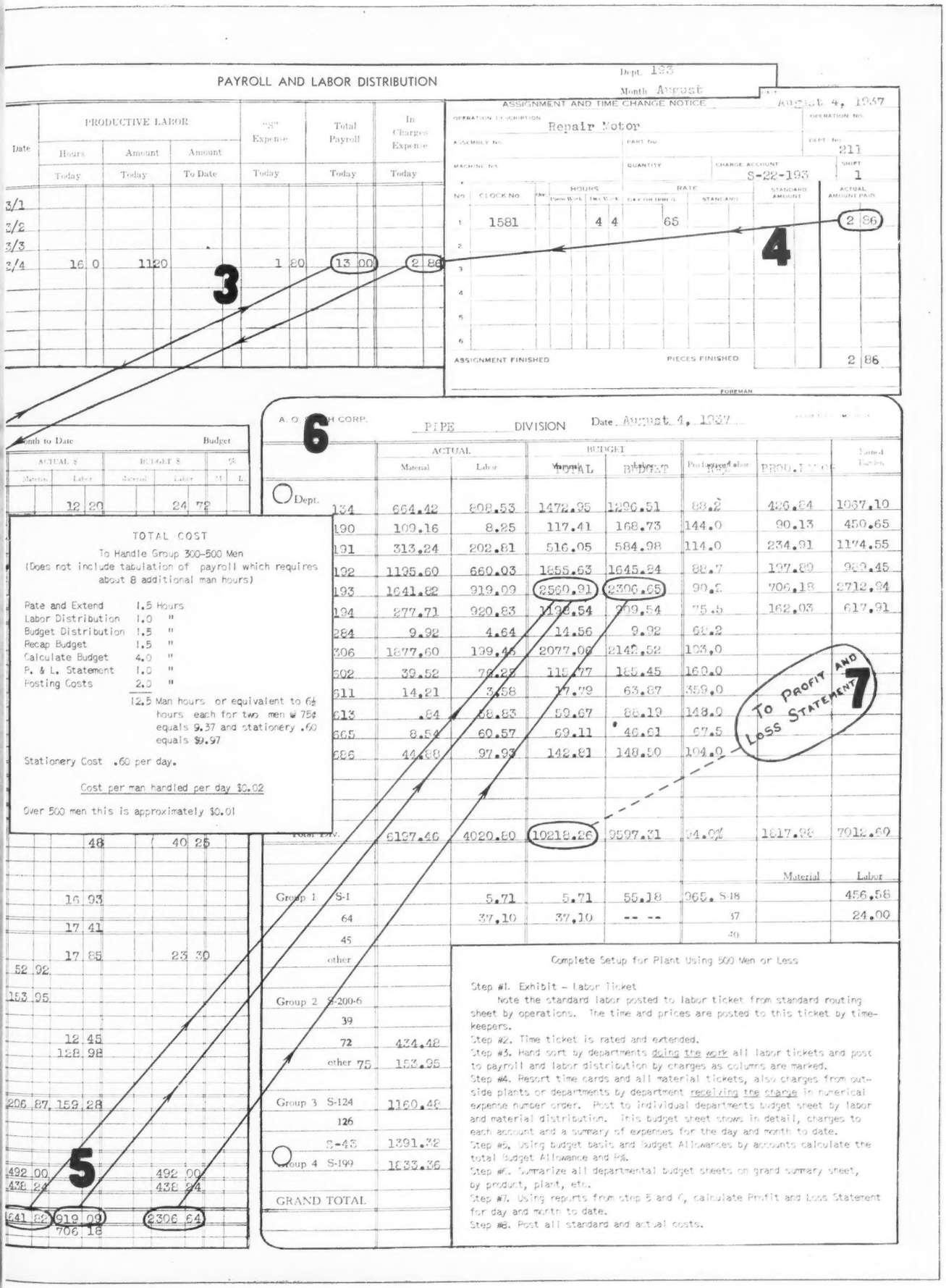
REQUISITION FOR MATERIAL

2.57	2	5	14	2	Pr.	4	Goggles

5 14 — 193

This Date

	Actual $ Material	Actual $ Labor	Budget $ Material	Budget $ Labor
MAINTENANCE				
S-22 Elec. Equip.		2 86		
25 Rep. to Light				
26 Bldg. & Grounds				
27 Dies, Jigs & Fix.		58		
28 Rep. to Equip.	74	45 43		
29 Rep. to Machy.	3 52	7 75		
30 Rep. Per Tools	2 82	3 71		
Total	7 08	60 33		
MISCELLANEOUS				
S-24 Moving				
35 Extra. Exp.				
36 Experimental				
55 Safety Exp.	5 14			
57 First Aid Treat.		1 35		
63 Vacation & Dis. Pay				
67 Conference Exp.				
132 Inbound Transportation				
Total	5 14	1 35		
000				
TOTAL NORMAL EXPENSE	40 62	207 30		
OVERTIME PREMIUMS, ETC.				
S-1 Lost Time		48		
8 Premiums				
58 Wage Guarantee				
65 2nd and 3rd Prem.				
66 Time Allowance		4 63		
Total		5 11		
EXCESS LABOR & MATL				
S-92 Repairs to Product		7 10		
92 Scrapped Product				
S-94 X-Ray Repairs				
95 Excess Mat'ls				
96 Errors				
97 Tool Development				
200 Excess Labor		12 45		
201 " "		23 97		
205 " "				
205 " "				
206 " "				
Total		43 52		
S-122 Water				
124 Steam Power				
126 Elec. Power				
Total				
S-199 Rental	123 00			
S-43 Dep. Dies, Jigs, Etc.	109 56			
GRAND TOTAL	273 18	255 93		
BASE		179 43		



PAYROLL AND LABOR DISTRIBUTION

Dept. 133

Month August

Date	PRODUCTIVE LABOR Hours Today	PRODUCTIVE LABOR Amount Today	PRODUCTIVE LABOR Amount To Date	"S" Expense Today	Total Payroll Today	In Charges Expense Today
3/1						
3/2						
3/3						
3/4	16 0	1120		1 80	13 00	2 86

3

ASSIGNMENT AND TIME CHANGE NOTICE

August 4, 1937

OPERATION DESCRIPTION: Repair Motor

OPERATION NO.

ASSEMBLY NO. | PART NO. | PIECE NO. 211

MACHINE NO. | QUANTITY | CHARGE ACCOUNT S-22-193 | SHIFT 1

No.	CLOCK No.	INX.	HOURS Day Work	HOURS Ins. Work	RATE DESCRIPTION	RATE STANDARD	STANDARD AMOUNT	ACTUAL AMOUNT PAID
1	1581			4 4		65		2 86
2								
3								
4								
5								
6								

ASSIGNMENT FINISHED | PIECES FINISHED | 2 86

FOREMAN

4

A. O. [illegible] CORP. PIPE DIVISION Date August 4, 1937

6

	ACTUAL Material	ACTUAL Labor	BUDGET TOTAL	BUDGET Labor	Productive Labor	PROD. INDEX	Earned Burden
Dept. 134	664.42	808.53	1472.95	1296.51	88.2	426.84	1067.10
190	109.16	8.25	117.41	168.73	144.0	90.13	450.65
191	313.24	202.81	516.05	584.98	114.0	234.91	1174.55
192	1195.60	660.03	1855.63	1645.24	88.7	197.89	989.45
193	1641.82	919.09	2560.91	2306.65	90.1	706.18	2712.94
194	277.71	920.83	1198.54	209.54	75.5	162.03	617.91
284	9.92	4.64	14.56	9.92	68.2		
306	1877.60	199.45	2077.06	2142.52	103.0		
602	39.52	76.25	115.77	185.45	160.0		
611	14.21	3.58	17.79	63.87	359.0		
613	.84	58.83	59.67	86.19	148.0		
665	8.54	60.57	69.11	46.61	67.5		
686	44.88	97.93	142.81	148.50	104.0		
Total Exp.	6127.46	4020.80	10218.26	9597.31	94.0%	1617.98	7012.60

		Material	Labor
Group 1	S-1	5.71	5.71
	64	37.10	37.10
	45		
	other		
Group 2	S-200-6		
	39		
	72	434.48	
	other 75	153.95	
Group 3	S-124	1160.48	
	126		
	S-43	1391.32	
Group 4	S-199	1633.36	
GRAND TOTAL			

		Material	Labor
Group 1	S-18	965.	456.58
	57		24.00
	40		

TO PROFIT AND LOSS STATEMENT 7

TOTAL COST

To Handle Group 300–500 Men

(Does not include tabulation of payroll which requires about 8 additional man hours)

Rate and Extend	1.5 Hours
Labor Distribution	1.0 "
Budget Distribution	1.5 "
Recap Budget	1.5 "
Calculate Budget	4.0 "
P. & L. Statement	1.0 "
Posting Costs	2.0 "
	12.5 Man hours or equivalent to 6½ hours each for two men @ 75¢ equals 9.37 and stationery .60 equals $9.97

Stationery Cost .60 per day.

Cost per man handled per day $0.02

Over 500 men this is approximately $0.01

Complete Setup for Plant Using 500 Men or Less

Step #1. Exhibit – Labor Ticket
Note the standard labor posted to labor ticket from standard routing sheet by operations. The time and prices are posted to this ticket by time-keepers.
Step #2. Time ticket is rated and extended.
Step #3. Hand sort by departments doing the work all labor tickets and post to payroll and labor distribution by charges as columns are marked.
Step #4. Resort time cards and all material tickets, also charges from outside plants or departments by department receiving the charge in numerical expense number order. Post to individual departments budget sheet by labor and material distribution. This budget sheet shows in detail, charges to each account and a summary of expenses for the day and month to date.
Step #5. Using budget basis and budget Allowances by accounts calculate the total Budget Allowance and P%.
Step #6. Summarize all departmental budget sheets on grand summary sheet, by product, plant, etc.
Step #7. Using reports from step 5 and 6, calculate Profit and Loss Statement for day and month to date.
Step #8. Post all standard and actual costs.

5

IV. Distribution of Burden

WE have seen the advantages of the variable budget from an operating point of view. We have seen how management may use it in day-by-day control of operating factors, how management may get control by *exception*, a control that can be altered and adapted to meet all conditions and fit the requirements of all types of people. In this and the following section I shall cover the application of these factors to lines of product.

The control of a department or even of a group of individual departments is not unusual. Control of departments by lines of products usually is considered difficult. By the use of a simple yet complete illustration I shall attempt to show that this control is not only relatively easy, but practical and necessary if management desires to control costs without the constant influence of *volume* distortion of their figures.

Consider that we are in a business making two products, a heavy job-order product and a light mass-production product. Consider further that these products are both built up from castings made in our own foundry. Our company operates a maintenance department, keeps cost records for departmental control of expenses, and maintains a factory and management organization department. We could add many more departments to this set-up, but this should be enough to illustrate a cross-section of the problem.

What are the factors involved? How much of the foundry expenses should be charged to line one, to line two? How much of the other departments should be charged? Of course the first reaction is: "That's not hard. *The charge should be in proportion to the use by these departments.*"

If we admit that the principles of the variable budget are right, we cannot use such an answer for we fail to consider the influence of the readiness to serve. For example, if the heavy job-order line is running strong and the light mass-production line is down, why should the line doing well absorb the standby charges and the fixed expenses in the contributing department? Some cost people and even some managements contend that it should because the first principle of costing is to get rid of the actual charges.

Right there, I believe, lies one of the greatest fallacies in modern business. *The casual charging of expenses to any line that can stand them in order to insure the complete liquidation of expenses is dangerous,* because:

1. Costs of poor lines are absorbed by good lines and thus the poor lines are not weeded out as they should be.

2. The sales department gets a wrong impression of the margins of lines and may push the wrong lines.

3. Profits may be seriously reduced because the line being favored may have a low selling price resulting in increased sales.

With these thoughts in mind, let us analyze the departments referred to above:

1. Foundry
   Production for both lines
2. Assembly No. 1
   Makes mass-production product
3. Assembly No. 2
   Makes large job-order product
4. Maintenance Department
   Makes all maintenance and machine repairs for the entire plant
5. Cost Department
   Keeps all records for the plant
6. Supervision or Management
   Supervises complete plant
7. Selling and Administration
   Sells both products

Considering the conditions expressed by the tabulation (Exhibit XII), we find that the following factors are important:

1. The foundry is a unit cost department—that is, it bills the apparatus departments for output at so much a pound or piece just as though the product were bought from the outside.

2. One of the apparatus departments is a standard cost department; the other uses actual costs.

3. The productive labor of the sales in Department No. 1 is 10 per cent; in Department No. 2 this percentage is 14 per cent. This means:

a. Department No. 1 is no doubt more highly mechanized or that Department No. 2 has fewer labor saving devices, or more hand work.

b. Department No. 2 might suffer if *all* burden were prorated on a base of productive labor.

In our analysis of these conditions we find that the expenses in Exhibit

EXHIBIT XII

OPERATING STATISTICS FOR NORMAL* MONTHS

DEPARTMENT	BASIS OF BILLING	NORMAL VALUE OF SALES	PRODUCTIVE LABOR	EXPENSE OR BURDEN	% EXPENSE TO PRODUCTIVE LABOR
Foundry	Unit Cost	$ 8,000	$ 1,000	$ 1,500	150%
Assembly #1	Std Cost	100,000	10,000	20,000	200%
Assembly #2	Actual	75,000	10,500	18,000	171%
Maintenance	"	-	-	5,000	23%/
Cost Dept.	"	-	-	1,000	5%/
Supervision	"	-	-	3,000	14%/
		$183,000	$21,500	$48,500	226%

* By NORMAL is meant a balanced related output at the most efficient level.
/ This percentage is to the total plant productive labor.

EXHIBIT XIII

ANALYSIS OF THE FIXED AND VARIABLE RELATIONSHIP

DEPARTMENT	PRODUCTIVE LABOR	- See Exhibit XII - FIXED EXPENSE	VARIABLE EXPENSE	RATE OF VARIABILITY PER $ PROD. LABOR
Foundry	$ 1,000	$ 500	$ 1,000	$1.00 per $ own P Labor
Assembly #1	10,000	9,000	11,000	1.10 per $ own P Labor
Assembly #2	10,500	6,000	12,000	1.14 per $ own P Labor
Maintenance	21,500*	2,000	3,000	0.14 Total Prod Labor
Costs	21,500*	500	500	0.023 " " "
Supervision	21,500*	2,000	1,000	0.047 " " "
	$21,500	$20,000	$28,500	$1.30 Total Prod Labor.

* Total all productive labor

XIII are divided between the fixed and variable elements. We also see that the conditions expressed are borne out here, the fixed expense in assembly Department No. 1 being greater than in No. 2.

In order to reduce their productive labor content and compete in the open market, Assembly Department No. 1 has all the up-to-date equipment. This condition, coupled with all the other factors prevailing when a department is highly competitive, accounts for the fixed expense being higher than in Department No. 2.

Notice that at normal operation the fixed expenses usually run from 35 to 50 per cent of the total expenses. ($20,000 is 41.2 per cent of $48,500). This is true when depreciation is a part of the fixed expense. When depreciation is not included, the total fixed expense at normal operations should never exceed 25 per cent. This is important because it is common practice when considering a variable budget to slight the fixed expense. The best budget is one that faces all the fixed expenses squarely and shows them in their true light.

Readiness to Serve

By Exhibit XIV it is seen that the distribution of fixed costs by departments has been made on a basis of readiness to serve which can be predetermined. The advantages of such procedure are many, the principal ones being:

1. More uniform costing between lines.

2. Fixed expenses can be prorated in advance and thus permit a study of lines and loads in advance of operations.

3. Fixed burden rates can be determined accurately.

4. Decisions can be based on facts.

Distribution of the variable expenses, or burden, should be made on a current basis. In most cases this is productive labor. As I have said, there may be other measures of current activity. If so, they should be used. In our illustration productive labor is used as the best measure of current activity.

By analysis we are able to determine a *factor* for the two operating departments and for the foundry which if followed will liquidate the variable expenses for the several non-productive departments and which can be used in advance to determine any set of operating conditions. When tied in with the fixed expenses, a set of factors is produced which can be used at will. Let us assume three varied operating conditions for illustration.

An analysis of any one of the departments listed in Exhibit XV will show the importance of these factors when the volume variance is substantial. In order to bring out the im-

EXHIBIT XIV

DISTRIBUTION OF FIXED EXPENSES TO LINES OF PRODUCT

FROM DEPARTMENT Read down
TO DEPARTMENT Read across.

F-Fixed Expense V-Variable Expense

DEPARTMENT	BASIS OF DISTRIBUTION	SUPER-VISION	COSTS	MAINT-ENANCE	FOUNDRY	ASSEMBLY #1	ASSEMBLY #2
Supervision	½ Capital Investment.) ½ Normal Full Time Men)	-	F	F	FV	FV	FV
Costs	Normal Output of Depts.	-	-	FV	FV	FV	FV
Maintenance	Investment in Grounds) and Buildings)	-	-	-	FV	FV	FV
Foundry	NORMAL services to) lines of products)	-	-	-	-	F	F

ACTUAL DOLLARS AND CENTS DISTRIBUTION FROM ABOVE FIXED EXPENSES ONLY

Figures in $		SUPER.	COSTS	MAINT.	FOUNDRY	APPARATUS	
Supervision	Own Fixed Expenses	$2,000	$100	$200	$300	$600	$800
Costs	Fixed Exp. From Others		100)	50	150	150	250
	Own Fixed Expenses		500)				
Maintenance	Fixed Exp. From Others			250)	400	1050	800
	Own Fixed Expenses			2 000)			
Foundry	Fixed Exp. From Others				850		
	Own Fixed Expenses				500	•	•
Assembly #1	Fixed Exp. From Others					1800	
	Own Fixed Expenses					9000	
Assembly #2	Fixed Exp. From Others						1850
	Own Fixed Expenses						6000
TOTAL EXPENSES TAKEN TO APPARATUS DEPARTMENTS					$1350	$10800	$7850

EXHIBIT XV

DISTRIBUTION OF FIXED AND VARIABLE EXPENSES IN DEPARTMENTS

	Figures in $ DEPARTMENT	PRODUCTIVE	- - VARIABLE PART - - - - - MAINT-ENANCE	COSTS	SUPER-VISION	TOTAL	FIXED EXPENSE	TOTAL ASSESSED	
	Variable Rate from Exhibit XIII		$0.140	$0.023	$0.047	$0.210	-	-	
CASE ONE	Assembly #1	$10,000	$1,400	$230	$ 470	$2,100	$1,800	$3,900	39%
	Assembly #2	10,500	1,460	247	483	2,190	1,850	4,040	39%
	Foundry	1,000	140	23	47	210	850	1,060	106%
		$21,500	$3,000	$500	$1,000	$4,500	$4,500	$9,000	42%
	Ratio of Expense to Prod) Labor)		14%	2.3%	4.7%	21%	21%	42%	
CASE TWO	Assembly #1	$5,000	$700	$115	$235	$1,050	$1,800	$2,850	57%
	Assembly #2	15,000	2,100	345	705	3,150	1,850	5,000	33%
	Foundry	2,000	280	45	95	420	850	1,270	64%
		$22,000	$3,080	$505	$1,035	$4,620	$4,500	$9,120	42%
	Ratio of Expense to Prod) Labor)		14%	2.3%	4.7%	21%	21%	42%	
CASE THREE	Assembly #1	$13,000	$1,820	$300	$610	$2,730	$1,800	$4,530	35%
	Assembly #2	5,000	700	115	235	1,050	1,850	2,900	58%
	Foundry	1,500	210	35	70	315	850	1,165	78%
		$19,500	$2,730	$450	$915	$4,095	$4,500	$8,595	44%
	Ratio of Expense to Prod) Labor)		14%	2.3%	4.7%	21%	23%	44%	

EXHIBIT XVI

ANALYSIS OF THE EXPENSES FOR DEPARTMENT #1

	- - Assessed Expenses Only - - - - Total All Expenses - - Case #1	Case #2	Case #3	Case #1	Case #2	Case #3
Productive Labor	$10,000	$5,000	$13,000	$10,000	$5,000	$13,000
Percent Prod.) Labor to Total) all Prod.Labor)	47%	23%	66%	47%	23%	66%
Total Variable) Expenses)	$2,100	$1,050	$2,730	$13,100	$6,550	$17,050
% to Prod. Labor	21%	21%	21%	131%	131%	131%
Total Fixed Exp.	$1,800	$1,800	$1,800	$10,800	$10,800	$10,800
% to Prod.Labor	39%	57%	35%	108%	216%	83%

portance of this condition, let us summarize Assembly Department No. 1.

Exhibit XVI contains much significant information relative to the importance of the fixed and variable elements in the control and distribution of expenses. One of the most important axioms of costing is shown. Scrutinizing carefully the percentages shown in Exhibit XVI, we find that the variable percentages are 21 per cent of productive labor in each case. A study of the ratios of fixed expense to productive labor shows that in Case 2 the ratio is 57 per cent, while in Case 3 the ratio is 35 per cent.

This brings us to the important axiom mentioned above. *When considered in relationship to the base which is usually the basis of recovery in costs, fixed expenses become variable to the base and variable expenses become fixed.* Stated in other words, because the variable expense is so many cents per dollar of base, if it is controlled so that there is 100 per cent realization from period to period, then it becomes a constant to the base.

An Important Relationship

In the same way, since the fixed costs or expenses are a constant figure, they become a greater percentage of the base as it diminishes and a lesser percentage of the base as the base increases in size. If we refer back to the theory of the variable budget in the first part of this series, we see this important relationship.

In my opinion this is one of the important rules of costing which static costs will never express. I feel that the sooner operating management is conscious of this relationship the sooner the organization will be conscious of variable costs and the sooner management will put emphasis on the problem of long-time control of fixed costs.

To show this cycle in a complicated working problem involving many departments, Exhibits XVII, XVIII and XIX are included. They show the application in a plant doing $3,000,000 business.

EXHIBIT XVII

Works Assessment

Basis for Distribution of Fixed Expenses Will Vary Under Different Conditions

General Plant	Normal Full Time Men
Personnel	Normal Full Time Men
Office Service	Normal Salaried Employees
Plant Protection*	Floor Space
Acctg. & Payroll & Tab	½ Capital Inv. – ½ Normal F. T. Men
Management	½ Capital Inv. – ½ Normal F. T. Men
Order & Stores†	Normal Material Input
Garage	Estimated Normal Service
Receiving and Stores	Normal Material Input
Yard Transportation	Estimated Normal Service
Wage Payment	Normal No. Wage & Planning Men
Material List	Estimated Normal Service
Inspection	Normal No. of Inspectors
Test	Normal No. of Test Men
B & G Engineering	Investment in Bldgs. & Grounds
Production	Normal No. of Production Clerks
Maintenance	Investment in Bldgs. & Grounds

* Adjusted for Department 23 because of having their own watchman.
† Adjusted for departments having decentralized Order and Stores Sections.

EXHIBIT XVIII

Actual Distribution of Works Assessments Schedule

Departments Receiving Assessments

	ASSESSED DEPARTMENTS												MANUFACTURING					NON-PRODUCTIVE DEPTS.												OTHERS	
	General Plant	Personnel	Office Service	Plant Protection	Management	Acctg. & Payroll	Order & Stores	Garage	Receiving & Stores	Yard Transport	Test	B & G Engineering	Production	Maintenance	Refrigerator	Locomotive	Foundry	Motor	Control	Warehouse	Salvage	Employees' Stores	Idle Plant	Transformer Idle	Restaurant	Power Station	AOH Gas	Pattern	Tool	Tool Design	Repair & Return	Laboratory	Eng. & Drafting
General Plant	F	F			F	F	F	F	F	F			F	F	FV	FV	FV	FV	FV	F	F					F	F	F	F	F			
Personnel		F			F	F	F	F	F	F			F	F	FV	FV	FV	FV	FV	FV	FV					F	F	FV	FV	F		F	F
Office Service					F	F	F	F	F				F	F	FV	FV	FV	FV	FV	FV	FV					F		FV	FV	F		F	F
Plant Protection									F					F	FV	FV	FV	FV	FV	FV	FV		F	F		F	F	FV	FV	F			
Management						F	F		F	F			F	F	FV	FV	FV	FV	FV	F	F					F	F	F	F	F		F	F
Acctg. & Payroll							F		F	F			F	F	FV	FV	FV	FV	FV	FV	FV					F	F	FV	FV	F		F	F
Orders & Stores									F					F	FV	FV	FV	FV	FV	FV	FV					F		FV	FV	F		F	F
Garage									F					F	FV	FV	FV	FV	FV	FV	F					F			F				
Receiving Stores														F	FV	FV	FV	FV	FV	FV	FV					F		FV	FV				
Yard Transportation														F	FV	FV	FV	FV	FV	F	F					F			F				
Wage Payment															FV	FV	FV	FV	FV														
Material List																FV		FV	FV														
Inspection															FV	FV	FV	FV	FV	F													
Test				F — FIXED											F	FV		FV	FV														
B & G Engineering				V — VARIABLE										F	FV	FV	FV	FV	FV	F						F							
Production															FV	FV	FV	FV	FV	F													
Maintenance															FV	FV	FV	FV	FV	FV	FV					F	F	FV	FV		V		

EXHIBIT XIX

ACTUAL WORKS ASSESSMENT - 1937

CONTROL DEPARTMENT BASE $9,126 Prod. Labor FULL SINGLE SHIFT

DEPARTMENT	FIXED	- - VARIABLE - - PER 10M $ WORKS BASE	TOTAL	TOTAL WORKS ASSESSMENT	VARIABLE PER $ OWN PROD.LABOR
General Plant	$113.91	$ 87.79	$ 80.94	$ 195.85	
Personnel	80.59	91.15	83.18	169.77	
Office Service	65.84	94.41	86.16	152.00	
Plant Protection	35.73	70.63	64.46	100.19	
Management	85.52	14.73	13.44	98.96	
Acctg. and Payroll	173.26	204.88	186.97	360.23	
Order and Stores	31.95	55.41	50.57	85.52	
Garage	3.53	32.64	29.79	33.29	
Receiving and Stores	122.64	119.28	108.85	231.49	
Yard Transp.	40.49	70.54	64.37	104.06	
Wage Payment	36.76	40.18	36.67	76.43	
Material List	43.20	97.45	88.93	132.13	
Inspection	17.35	11.30	10.49	28.04	
Test	19.31	31.37	28.63	47.84	
B & G Engineering	2.25	5.81	5.30	7.55	
Production	58.77	15.89	14.50	73.27	
Maintenance	59.77	18.47	16.85	76.62	
Total	$993.94		$971.10	$1,965.04	$0.1064

ACTUAL EXPENSE DISTRIBUTION - GENERAL PLANT

DEPARTMENT CHARGED	FIXED	VARIABLE	TOTAL CHARGED
Refrigerator Department	$ 215.93	$244.23	$ 460.16
Locomotive Department	165.97	101.46	267.43
Control Department (See above)	113.91	80.94	195.85
Foundry Department	118.25	47.17	165.42
Motor Department	392.19	220.16	612.35
Warehouse Department	21.70	------	21.70
Salvage Department	7.60	------	7.60
Pattern Department	10.85	------	10.85
Tool Department	31.44	------	31.44
Tool Design Department	2.17	------	2.17
Power Plant Department	9.55	------	9.55
AOH Gas Department	1.29	------	1.29
Total General Plant Expenses) Distributed)	$1,090.85	$694.96	$1,785.81

ACTUAL VARIABLE BUDGET OF WORKS ASSESSMENTS
WEEKLY BASIS

Actual Distribution for a period FULL SINGLE SHIFT

DEPARTMENT	BASE	FIXED EXPENSE	VARIABLE PER 10M $	VARIABLE TOTAL	TOTAL BUDGET
General Plant	$77,400	$1,091	$89.79	$695	$1,786
Personnel	82,830	765	91.15	765	1,520
Office Service	82,830	473	94.41	782	1,255
Plant Protection	82,830	406	70.63	585	991
Management	77,400	895	14.73	114	949
Acctg. and Payroll	82,830	1,598	204.88	1,697	3,295
Order and Stores	82,830	229	55.41	459	688
Garage	78,434	172	32.64	256	428
Receiving & Stores	82,830	474	119.28	988	1,462
Yard Transp.	77,400	652	70.54	546	1,198
Wage Payment	77,400	144	40.18	311	455
Material List	44,946	106	97.45	438	544
Inspection	77,400	65	11.50	89	154
Test	44,946	105	31.37	141	246
B & G Engineering	77,400	30	5.81	45	75
Production	77,400	184	15.89	123	307
Maintenance	82,833	612	18.47	153	765
Total		$7,941		$8,177	$16.118

V. Establishment of Modern Normal Rates

SINCE we have found a way to distribute our fixed and variable costs to lines of products without destroying the identity of the expenses between fixed and variable, we can now proceed to study the method by which we can establish a normal rate for the liquidation of expense. Let us consider a full definition of the problem.

By a normal rate we refer to that percentage which, on an average, will recover all the expenses we incur over a given period of time. Expressed in other words, if the average output of a department is $10,000 per month and this output represents $1,000 of productive labor and $2,000 of expense, then the relationship of expense to productive labor is 200 per cent. If this 200 per cent is applied to every productive labor dollar that is represented in output over a period of time, say one year, all expenses will be recovered.

Deferred and Prepaid Expenses

When expenses are not recovered, we refer to the unrecovered expenses as unliquidated expenses and show them as deferred expenses on the balance sheet. When we recover more than we spend, we call the excess expenses overliquidated, and call them prepaid expenses on the balance sheet.

If we have made a fairly intelligent estimate of the volume as reflected by productive labor, we find at the end of the period that the over- and underliquidations offset one another, and we have recovered our expenses.

Obviously this method is simple from a cost angle and substantial from an operating record point of view.

In order that we may carry out this principle, let us again consider Assembly Department No. 1, Exhibit XVI. Cases 1 to 3 indicate the various loads under which this department operates.

Assuming that normal operations call for $10,000 productive labor and that this represents 70 per cent of rated capacity, then the $5,000 in Case 2 represents 35 per cent capacity and the $13,000 productive labor in Case 3 represents 91 per cent capacity. In other words, the three cases represent approximate normal, minimum, and maximum operations of this line. For analysis see Table IV.

According to these figures, since $10,000 is normal load, the normal expenses are 239 per cent made up of 131 per cent (or 1.31) variable expenses and 108 per cent fixed expense. To see how the over- and underliquidation works, let us consider the case shown in Table V.

In these four months we have failed to recover our expenses by $1,275. Further, we can analyze this amount—something that is hard to do in most cost methods. $350 of this amount is due to poor realization of the budget; the balance, $925, is due to failure to operate at average load of $10,000 per period.

Thus the variable budget method not only establishes accurately the normal rate to be used in costs for the recovery of burden or expense, but makes easy the analysis of over- or under-absorbed burden to determine what part of it is due to poor realization of operating conditions and what part is due to failure to get load.

In some companies there is wide discussion of a plan of charging to the sales department that part of the under-absorption of burden due to lack of load.

Table IV. Analysis of Operations

Prod. Labor	*% Capacity*	*Expense Variable*	*At Capacity Fixed*	*At Capacity Total*	*% Expense to Productive Labor*	
$5,000	35	$6,550	$10,800	$17,350	347	
10,000	70	13,100	10,800	23,900	239	Normal
13,000	91	17,030	10,800	27,830	214	

Table V. Analysis of Over- and Under-Liquidation

Month	*Prod. Labor*	*Actual Expense*	*Budgeted Expenses*	*Over — or Under + Budget*	*Expenses Liquidated at 239%*	*Over — or Under + Liquidated*
Jan.	$9,300	$23,350	$23,300	$20—	$22,230	$1,120—
Feb.	11,100	25,200	25,310	100+	26,530	1,330+
March	10,700	24,990	24,870	120—	25,575	585+
April	8,800	23,100	22,780	320—	21,030	2,070—
		96,640	96,290	350—	95,365	1,275—

VI. A Tool of Profit-Minded Management

THERE are many other uses for the application of variable costs in modern business today. I have made no attempt to cover the entire field. For example, this method can be used in the determination of foreman's incentive. It can be found to be very useful in the study necessary to analyze lines to cull out the old and obsolete. Wherever a guide is needed to cover sets of related conditions, its application is almost unlimited. I have presented it because I believe it provides the gap between management and accounting needed today in our analysis of changing conditions.

As the late C. E. Knoeppel stated in his book, "Managing for Profits": "Some management is routine-minded, other management is volume- or production-minded, but the real management today, the management which will pass successfully into the future, is *profit-minded.*"

Profits never come from increased selling prices; they come from *decreased costs.* The way to get decreased costs is to control them. Here is a tool that will do it. It is expressive. It is simple and easy to handle. Real management will use it because real management must be *profit-minded* to the *n*th degree to cope with tomorrow's realities.

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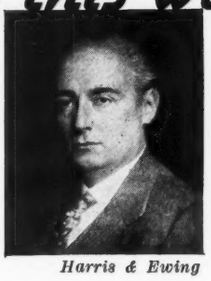
It's this way in Washington



Harris & Ewing

CARTER FIELD
Washington Correspondent

Looks like another "breathing spell." Mr. Roosevelt's present solicitude for business is no admission that he has been wrong about the undistributed profits tax or anything else. It is merely a form of bending before the gale—as a matter of fact, before two gales

HOW LONG the present "breathing spell" will last is the most important question confronting every business man, and especially every manufacturer, in the country. There have been signs a-plenty in the last month that the Administration is making that oft-predicted "turn to the right."

It might even be termed a partial admission that the New Deal has been guilty of one fundamental error—of belief that business could be conducted on such a small margin of profit that no allowance need be made for bad years. For this has been one of the cardinal ideas governing Roosevelt's conception of what the government should permit business to do, manifesting itself both in regulation and in taxes.

Congress has taken the bit in its teeth. It was evident that this would be the case days before Secretary Morgenthau made his notable speech in New York—a speech, by the way, which a year ago would have been denounced as the utterance of an economic royalist.

An Administration Blessing

Even the most loyal New Deal senators and representatives could read into the Morgenthau speech an Administration blessing on the passage of amendatory and repealing legislation that would be calculated to help business. For nothing is better realized on Capitol Hill than that, whatever Mr. Morgenthau may think privately, he *never* expresses publicly an attitude in conflict with that of the President.

Three tremendously important points were outstanding, in the talks of returning senators and representatives, *before* Mr. Morgenthau made this speech. These were:

1. Determination of Congress to modify sharply the tax on undistributed earnings, most of the members wanting to make allowances for building up reasonable reserves as well as liberalizing allowances for replacements and betterments. A minority even wanted outright repeal of the whole tax. Desire to relieve corporations in debt was almost unanimous.

2. Determination of Congress to revamp the capital gains tax, permit the spread of losses over two or more years, shorten the time securities or property must be held before the government would permit the minimum rate of tax on the profit.

3. Recognition of the necessity for larger profits for business than the Administration had deemed reasonable, in order not only to prevent wholesale failures during bad years but also to provide the necessary incentive to new capital.

The thing to watch for, of course, is how the White House pressure is applied later on, when the legislation takes form. In the case of the tax measures that time is yet in the future. But it is interesting to note that Senator George, of Georgia, one of the outstanding conservatives on the Senate Finance Committee, gave an interview to Atlanta newspapers immediately after the Morgenthau speech insisting on immediate action on the undistributed profits tax, without waiting for the general tax legislation.

There are some who think that Senator George wanted to strike while the iron was hot—to push through legislation removing the shackles from business while the Administration was still disturbed about the business recession, and before some new prophet could re-convince the President that his original ideas were sound.

There is much to study in that idea. For this *is* a breathing spell. There is no assurance whatever that the President believes the undistributed profits tax was mistaken policy, or that his idea about the ability of the New Deal planned economy to eliminate bad years is unsound.

It must not be forgotten that never, since Mr. Roosevelt entered the White House, has he changed his views about anything else. He laid the groundwork for nearly all the tax and regulatory legislation he has since advocated in his acceptance speech in 1932.

Most Washington observers believe, therefore, that the present phase of consideration for business, of conceding that profits should be larger than hitherto approved, is just a form of bending before a gale rather than standing firm and running the risk of breaking.

There were two gales, one already raging and the second clearly marked on the calendar. The first was the determination of Congress to ease the strain on business. There was no way of telling whether the President would be able to win even if he had decided to stand firm. A rebuff from Capitol Hill on business legislation, following so quickly his crushing defeat on the Supreme Court issue, would play into the hands of the Southern conservatives who are playing their cards to control the Democratic National Convention in 1940 and prevent the nomination of a New Dealer.

Expediency's the Thing

Weighing the elements of this problem will make it clear why there has been so little outcry against the present conservative trend from the extreme left fringe of the President's advisers. The answer is simple. They believe in expediency, yielding a little now to make it possible to gain more later on.

The later gale which also gives the Administration pause in any thought of a last-ditch stand against modification of policies is the November 1938 election. Even if the fight against the conservatives on Capitol Hill could be won, which is very doubtful, its very winning might result in severe reversals at the polls in the midterm election. Which in turn would strengthen the hands of the Democrats who hope to nominate a conservative for Roosevelt's place in 1940.

All of which might seem most encouraging. But a word of warning! Roosevelt is an extraordinarily resourceful fighter; he never quits.

Only a 30-Man Plant—But It's Mass-Production

Very small plant with very big-plant ideas breaks down old alibi: "It may work in your automobile factory, but we're too small. It won't work here"

As told to the editor by

T. B. FUNK

President, Yard-Man, Inc.
Jackson, Mich.

HOW FREQUENTLY one hears the complaint: "But it won't work in our small shop. You can't introduce production methods here. The plant is too small." Yet that is just what we are doing, and have been doing successfully for the past five years, at Yard-Man, Inc. Our plant employs 30 operators and produces exactly 30 lawn mowers per hour, mowers finished to precision limits for silent operation. Each of the jobs involved in the process is balanced so that one mower can be produced every two minutes.

No Cross-Hauling

Steel rolled with company-owned rolls is received from the steel mills in carload lots and piled in special racks immediately adjacent to the two presses that cut the blades and cutter bars to length. These presses are adjacent to the heat-treat furnace which in turn is fed in sets, one cutter bar to five blades.

From this furnace the blades go into a specially designed twisting machine and are oil quenched. The cutter blades are riveted to the web which in turn is welded to the shaft. Remember, each operation is keyed to every other; there is one complete processing operation every two minutes.

After riveting the blades to the web, the web must be welded to the shaft at six points. A merry-go-round fixture does two things in a very effective way. It delivers the reel to the welder in a proper upright position for this welding job. It also acts as an inspection operation—the web must be the proper distance from the end of the shaft.

This is done by the operator when he places the reel in its upright position on the circumference of the merry-go-round. Mounting the fixture at a slight angle results in the loaded reels moving by gravity to the welder located at the low point opposite.

To relieve the strain set up in riveting, the assembled reel must be normalized, and this furnace with potentiometer is just where it may be loaded from the riveting operation. There are no banks of material. Production is perfectly balanced.

Now we come to the first conveyor. The reels and cutter bars, again in sets, are placed on carriers attached to an overhead chain conveyor which services the double row of grinders. The operator takes off a reel, grinds it, and replaces it on the same conveyor. There are no banks. The reel, spacer bar, and end plates constitute the chassis. These meet at the assembly bench at the end of the grinding conveyor. This bench is at the confluence of four separately balanced units—the reel, the end plates, the spacer tube, and the wheel gears—and they come in just the right quantities for the chassis assembler to perform his task without having to seek his parts, and without having too much of this and too little of that.

Christmas Tree Conveyor

The end plates, drilled and reamed in balanced operation, feed in from his right, the reels from the conveyor to his left. Across the bench are the degreaser and spray booth.

The degreaser operator loads the paint and assembly conveyor. The chassis, two wheels, handle bar braces, roller bar brackets, hub covers, and handle bar ferrules are hung on this conveyor, again in sets, each set making one mower. The spray booth operation is a veritable machine gun nest, with a gun for each color required.

This same conveyor elevates the sprayed parts on a trip through a gas-fired baking oven and back along the side of the building for the final assembly of the mower, at a level that permits assembly in a standing position and without removing the parts from the conveyor.

Operators Do Several Jobs

Of course, with a small plant, we cannot have, nor do we need, one or more operators for each job. Balance may be attained by having one operator do several jobs, but layout of the operations must be such that this may be accomplished without loss of time in moving from one machine or operation to the next.

This may be done with individually driven equipment and with portable small jobs which may be introduced here and there to utilize idle time of operators on main operations.

We have a number of these jobs in which no sequence is required and where the equipment, such as a drill press, may be moved about as desired. The operator truing the rim has some extra time, so he is given a test job in running-in the gear and pinion. He need only make a quarter turn to feed this machine.

Another job illustrating the same principle is giving the adjusting screw a taper, accomplished on a

small press placed in a group of machines operated by one man, who also attends to three Potter and Johnstons and a drill press.

These jobs are timed out initially and placed accordingly, but we can verify our balance by observing whether work piles up on the operator. If it does, the portable machine is plugged in somewhere else, the result being balanced flow without crowding our operators.

Every Operator an Inspector

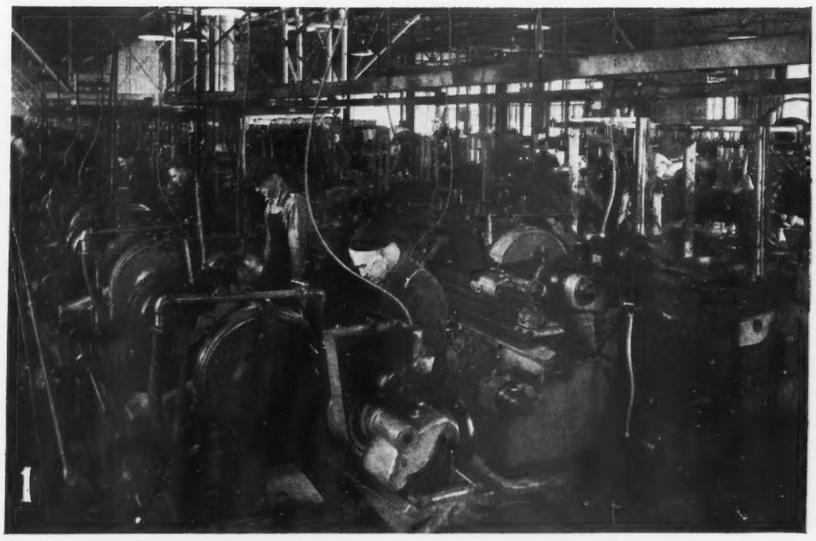
It is our policy to have each operator inspect the work as it comes to him. In addition to this, however, several more or less automatic inspections are planned during the process. One has already been mentioned, the web distance from the end of the shaft which is insured when the riveting operator places it in the merry-go-round.

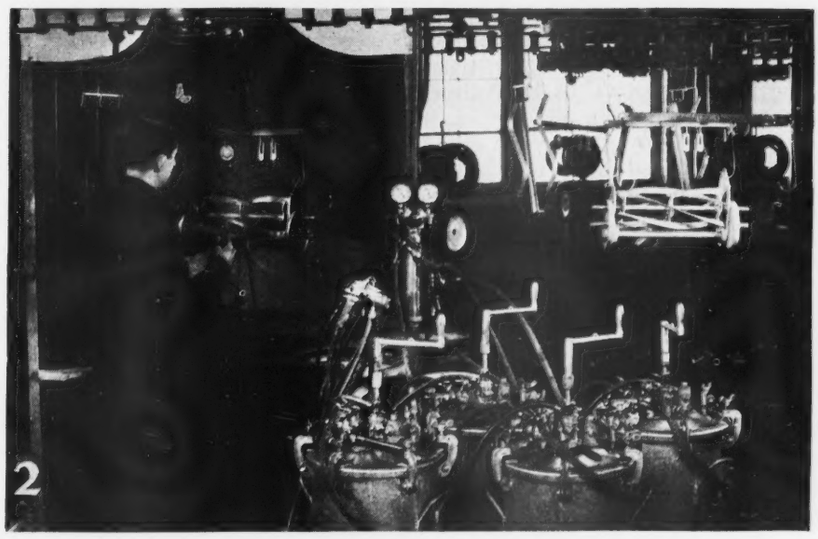
Another such inspection, performed by a production operator, is running in the gear and pinion to eliminate all slugs on the teeth. Others might be mentioned, but the point is made that this policy avoids the use of floating inspectors and serves to emphasize quality in the minds of the employees.

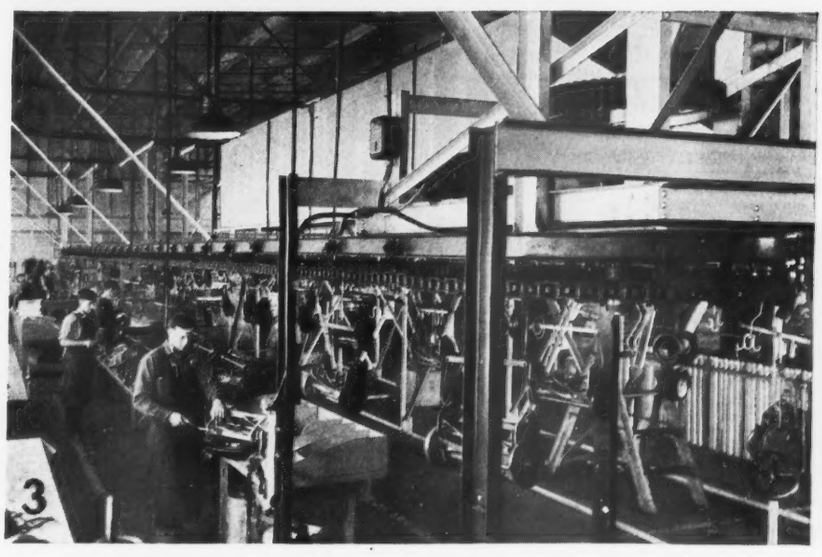
Tending in the same direction is the method of wage payment. All employees share equally in the piece rate established for each completed mower, insuring in this way a community of interest in quality output. But we recognize that jobs are of different values. The spray booth operator, the welder, and the grinders are given a differential of so many cents per hour above their piecework earnings, an incentive superimposed on an incentive as it were.

Limited Variety for Efficiency

To be sure, the things we have been discussing — straight-line sequential arrangement of equipment, balanced operations, portable operations, absence of cross-hauling of parts, and arrangement of machinery in a semi-circular pattern for convenience of the operators— result in smooth operation and satisfactory costs. These things flow naturally out of our design policy. We do not attempt to build every variety of lawn mower in existence. Our mower is designed and built to high-quality standards and in four widths only, all fixtures being designed to handle these widths in whatever sequence scheduled without change in set-up.



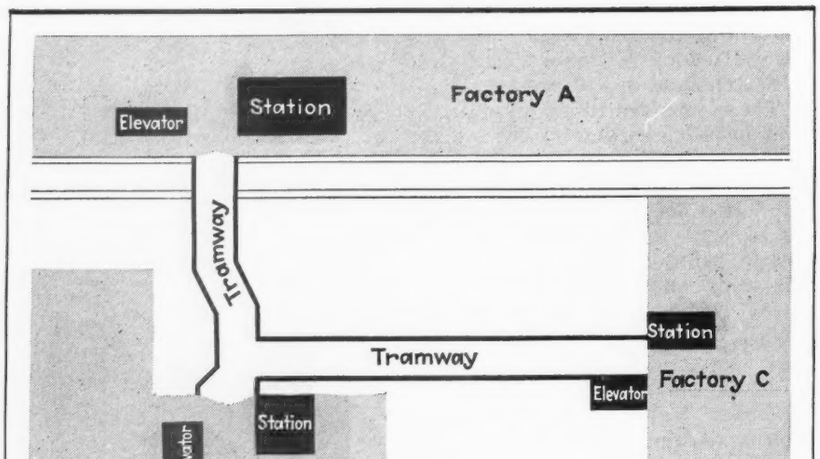




1. Production is perfectly balanced. There are no banks. Reels and cutter bars are moved in sets via overhead chain to grinders

2. Paint booth is a veritable machine-gun nest, a gun for each color

3. Overhead baking oven and chain conveyor that serves assembly line



Four Men Make All Moves

Centralized trucking does away with the wasteful practice of having production men move materials

S. R. TERANES
Industrial Engineer
Hamilton Manufacturing Co.
Two Rivers, Wis.

MANY PRODUCTIVE hours are lost daily because production men have to move materials and look for trucks and dollies. To eliminate this loss, we made a study of the inter-departmental trucking situation. A crew of move men was set up with a supervisor in charge. It is the latter's duty to see that materials are moving properly, that empty trucks, dollies, and lift-truck platforms are furnished where needed. He also assists any member of the crew who is especially rushed.

Three distributing stations were then set up, one in each building. One man in each building operates the elevator and delivers materials from one department to another. Also, when a load is at the distributing station and is to be delivered to a department in his section, he is to move it to the proper department. If a load is to be moved to one of the other buildings, he moves it to the distributing station.

No Shortage Now

One member of the crew moves all materials across the tramways from one distributing station to another.

The plan has helped to cure the empty truck and dolly shortage. Under the old system, when one operator accumulated several trucks, he would not release any. Consequently, one man would have more than he could use for one day's production while another was losing time looking for trucks.

In one department the foreman had one man appointed to look for trucks only. He became so proficient on his job that he would always have 20 to 30 trucks ahead in his department while the others were short. Because of his ability to locate empty trucks, he was appointed supervisor of the moving crew. Now he must see that all departments are furnished with trucks instead of only one. And he is doing it too.

One reason for the shortage of empty trucks was that many of them stood loaded for a long period of time. To remedy this condition, the moving crew was given the authority to unload any truck that they knew could be unloaded or take away any excess trucks any operator might have.

The departmental foremen also use the moving crew to get parts out of stock. Several of the departments, through lack of space, have to keep sub-assemblies or unfinished parts in other parts of the plant. When in need of such stock, the foreman makes out a requisition, places it in a holder provided for it near the elevator. The elevator or move man in that building picks up the requisition on his trip and delivers it to the distributing station. The tramway move man picks it up and on his regular trip delivers it to the building where the stock is stored. The move man in that building loads up the stock and places it in the distributing station, and in a short time the stock is in the department requesting it.

Maintenance cost of the moving equipment has been considerably reduced. Formerly, when a truck was in need of repairs, it was placed in a corner and left there unless the superintendent happened to see it and ordered it repaired. The move crew have the necessary tools to keep the equipment in repair by tightening loose bolts, oiling, etc. When extensive repairs are necessary, the equipment is taken to the millwright for necessary repairs.

The plan has had these results. Movement of materials has been expedited. Less merchandise is damaged in transit. Cost of moving has been reduced, loss of production time practically eliminated.

Laid Out for Least Handling

Straight-line flow replaces functional layout in Westinghouse's new a.c. motor set-up, saves 25 operations, 22 moves, and three miles of travel

G. A. VAN BRUNT
Associate Editor

TO THOSE who are faced with the task of turning out more units of product in the same floor space, we commend the combination of modern handling and modern layout methods used so successfully by the Westinghouse Electric & Manufacturing Company in its new a.c. motor factory at the East Pittsburgh Works.

Old layout was of the conventional job-order type, consisting of widely separated functional process groups like the punch press department, shaft cut-off department, etc. That meant 67 operations, 65 moves, 17,760 feet of travel.

New layout provides for straight-line flow of materials all the way from raw stock to finished motors. Operations are now only 41 in number, moves 43. Total travel has been reduced to 3,420 feet.

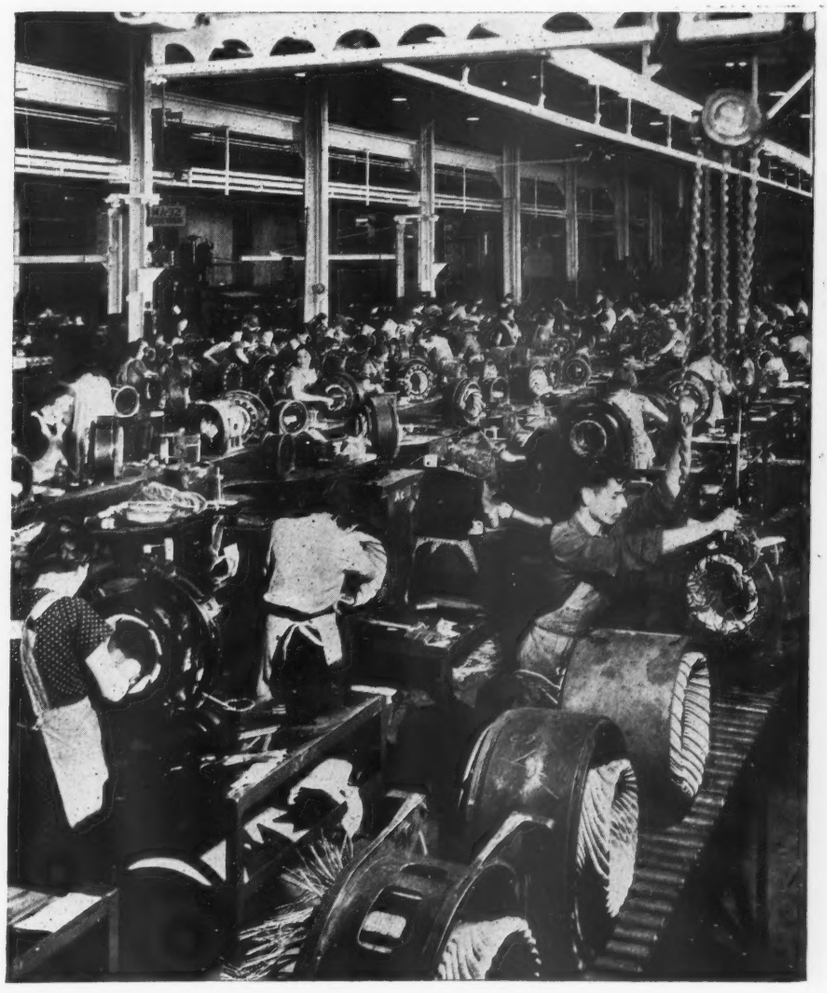
Increased Output

Among the results may be counted these advantages and economies:

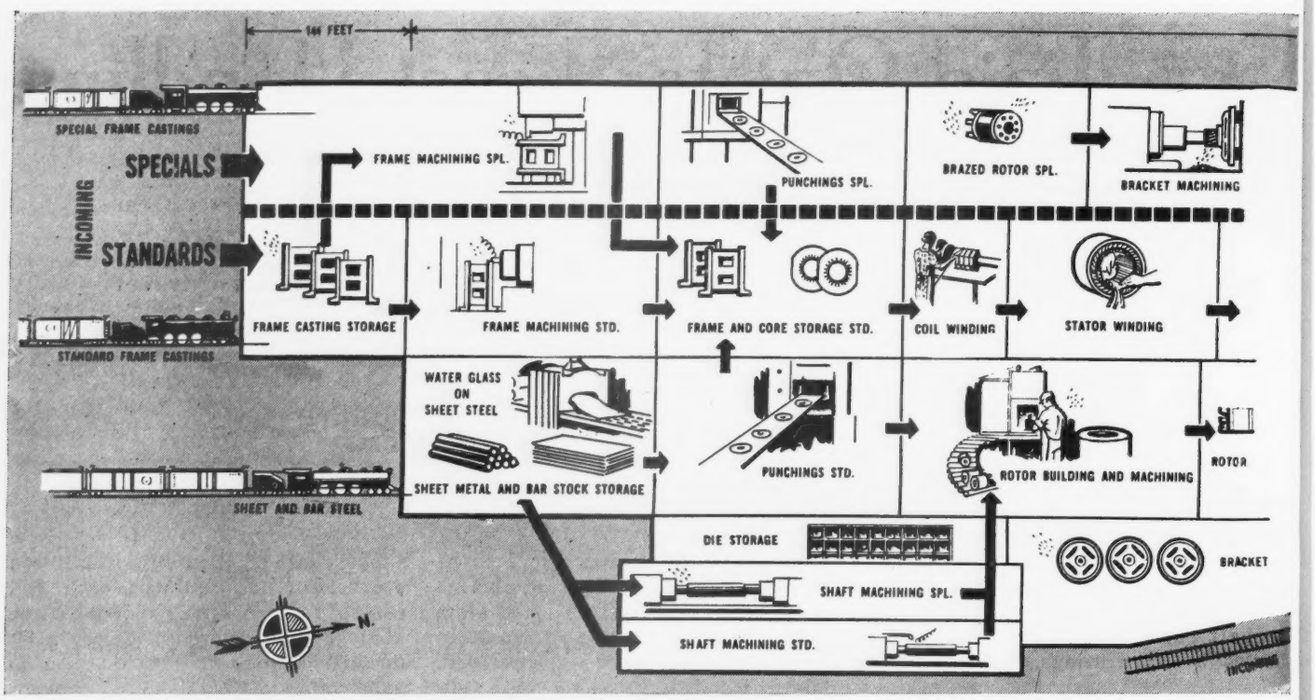
1. Output has been increased.
2. Production is better controlled and regulated.
3. Porters formerly engaged in non-productive labor have been released for profitable work.
4. Floor space given over to wide aisles necessary for the passage of hand trucks, has been reclaimed and put to profitable use.
5. Accident hazards have been reduced.
6. Investment in stock in process has been lessened.
7. The manufacturing interval has been greatly shortened.
8. Better physical condition of stock is insured.
9. Means for better control of quality have been provided.
10. Chances for overlooked orders have been eliminated.

To accomplish all this, some 270,000 sq.ft. of floor space had to be reconditioned. Handling equipment and facilities for motors rated from 1 to 50 hp. and weighing from 50 to 1,500 lb. apiece had to be provided. They included gravity roll, belt, chain, slat, and live roll conveyors and crane facilities ranging from a simple chain hoist on a jib to a 10-ton overhead crane equipped with full control for operation from the floor.

Some $220,000 worth of the most modern machine tools were needed to supplement the available equipment. And thousands of dollars' worth of special tools and precision gages



Assembling coils in motor stators —showing some of the handling equipment that had to be provided



One line for "specials," another for "standards." Straight-line flow has replaced the old functional set-up. The chart shows how incoming materials move through processing to warehousing and shipping

General view of shaft machining department, showing conveyors, shaft pallets, and pull-off stands

were required in order to insure control of quality on a quantity production basis.

On the two following pages is a pictorial flow chart that illustrates the general scheme of handling incoming materials through manufacturing processes to warehousing and shipping. The flow of production is in two parallel lines, one for standard motors and one for specials. It is a simple matter to follow the arrows and get the complete picture for either type of product.

After the correct flow of production had been determined, the details of each production and handling center were worked out. Careful analysis of machine set-up time and cutting time integrated with expected production quantities established these points:

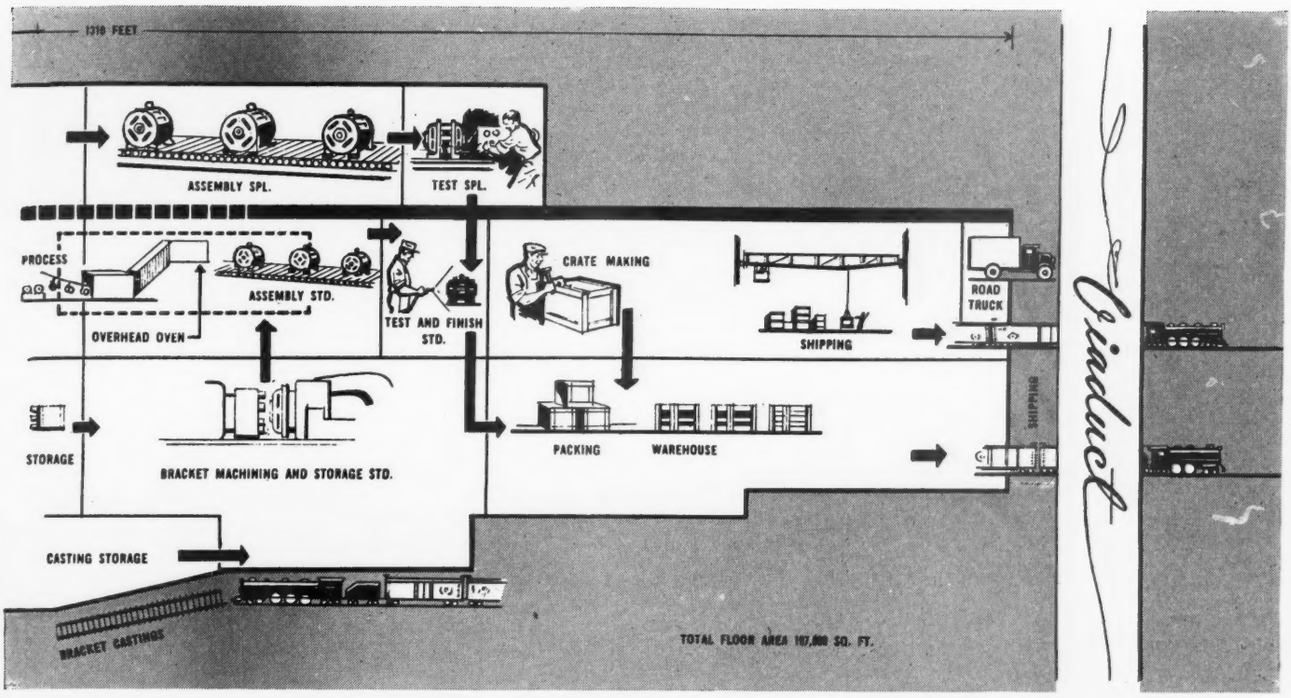
1. Loads on existing machines available for transfer to the new department.

2. New machines required to increase capacity.

3. Most efficient arrangement and grouping of machines.

4. Types of materials handling equipment required to facilitate efficient machine production.

5. Floor space requirements for each production center.



Typical production center is the one for machining standard cast-iron frames. Gravity roller conveyors feed and take away castings. Light bridge cranes with chain hoists are used to load frames into the machines. The 2-ton overhead bridge handles heavy fixtures in setting up the machines.

Indispensable Tools

Process flow charts have been constructed for such major parts as motor frames, punchings, shafts, brackets, and bearing cartridges. Never has the value of these indispensable tools of management been more clearly demonstrated. In no other way are wasted effort and chances to save more sharply revealed.

In this instance they afford direct comparison of the new method with the old and show savings in number of operations, number of moves, and amount of travel.

These savings have already been detailed. Reduced to percentages, they are respectively 39, 34, and 80 per cent. They are indicative of the savings that can often be made when modern materials handling is teamed with modern layout methods and the right kind of motion economy to increase output.

View of conveyor lines used for dispatching rotors and stators to the assembly department

Everyone in This Plant Gets a Share of the Profits

For fourteen years Hoskins Manufacturing Company has split profits three ways—some to stockholders, some to plant, some to employees. What better incentive?

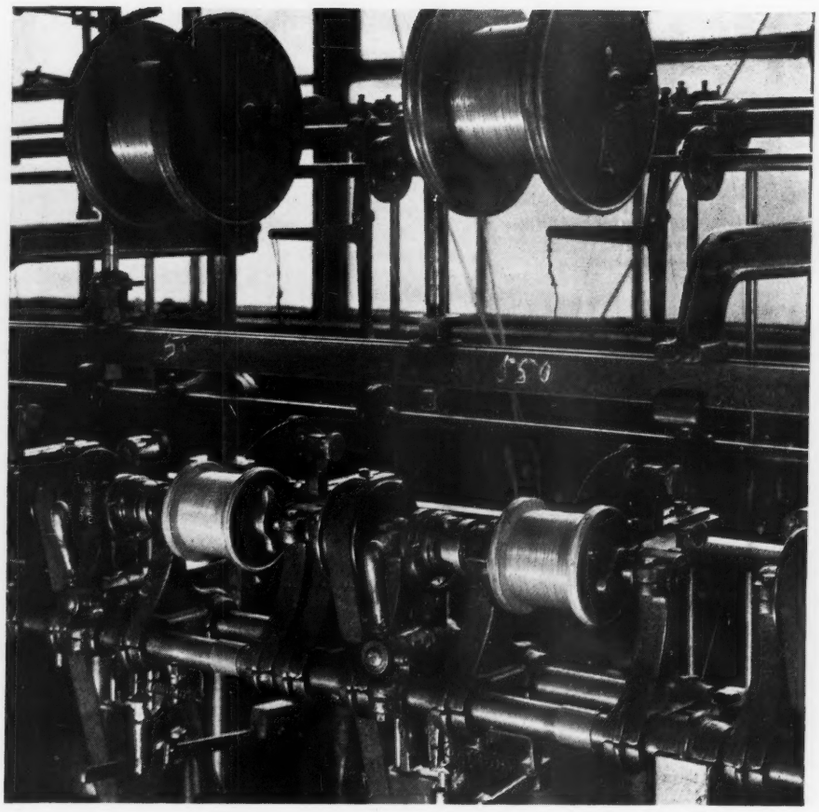
C. B. GORDY
Detroit Editor

EMPLOYEES of the Hoskins Manufacturing company of Detroit have, since 1923, shared regularly in the profits earned. Although such participation is voted yearly by the Board of Directors, it has become a settled policy whose results, although intangible in many respects, are distinctly worthwhile to the company and employees.

It must be understood at the outset that the regularity in such distribution (only in 1932 was there no sharing) is not due to absence of competition or to patent protection. There are many manufacturers of heat-resistant wire, and prices are distinctly competitive. But, due in no small measure to the cooperation secured from the working force, competition has been met during the fourteen years this plan has been in effect, and capital has been reasonably rewarded.

In 1923 an upturn in business began which was met in many places by an increase in salaries, justified by the activity of business and the increase in the cost of living. One difficulty of meeting the situation in this way, however, is the fact that when these same conditions change, a reduction is necessary in order to reduce overhead to meet competition at the reduced price level. Feelings of resentment are bound to arise under such circumstances, and just at the time when increased cooperation is necessary.

This very practical reason partially explains the origin of the idea as far



Pouring molten alloys from a high-frequency induction furnace (opposite page) becomes a safe operation with hoist and turntable

Regularity with which this company has shared profits is in no way accounted for by the type of product it manufactures

as salaried employees are concerned, but not entirely; nor does it explain the thinking underlying distribution of profits to factory workers.

The company had always figured that earnings should be divided three ways—that a portion should go to the stockholders as a reward for the use the company makes of their capital; that a second portion should go to the surplus account to insure the stability of the company and thus protect all interests when adverse conditions were to be met; that a third portion should go to the employees who helped to create the earnings. This basic belief, plus the practical salary situation in 1923, accounts then for the initiation of the plan at that time.

Division of the profits in this way gives everyone, from the man who sweeps the floor to the man who sits on the Board of Directors, a stake in the success of the company, and insures that all will cooperate in doing those things within the sphere of his own responsibility that will make the shares larger.

Losses, which fortunately have rarely occurred, are not shared. If profits are earned, they are shared; if there are no profits, the employees still enjoy the ruling wage rates, and salaried employees still receive reasonable compensation according to their responsibilities in the company. Profits are considered a part of salary and of wages. It should be understood also that cost-of-living adjustments are no part of the plan, and reductions that would follow a decrease in this level are thus avoided.

Furthermore, this sharing is not a Christmas bonus, predicated upon estimated earnings. It is not paid until some time in February, when the books have been duly audited and the profits correctly established. When this is done, a percentage of the capital value of the outstanding stock is deducted. In 1923 it was 8 per cent. Today, even though capital stock has been increased, the same lump sum (which now amounts to some 6 per cent on the outstanding stock) is deducted. A substantial part of what remains is paid to employees as extra compensation.

The original deduction of about 6 per cent of the value of the stock and the remainder of the profits following the employees' share serve as a reward to ownership and as additions to surplus.

The share going to employees is divided in relation to responsibility for the creation of the profits. All department heads are included in one group, with assistant department heads and salesmen in another. Factory employees and clerks comprise a third, made up of three classes.

All those with a service record of 5 years and over form one class; those with from 3 to 5 years' service form a second; and the last class is composed of those with a service record of from 1 to 3 years.

Those with 1 year or less of service do not participate. The number coming within this classification, however, is negligible. Labor turnover is almost non-existent, and very few new people have to be hired.

The portion of the earnings set aside for distribution to employees is divided equitably among these groups just mentioned, and participation within each group is in the proportion that yearly salary or wage bears to the total for each group. Fourteen years' experience has shown that these shares are substantial in amount. They are paid in a lump sum after outside accountants have determined net profits.

Of course the results of such a policy cannot be stated in exact figures, but the company is confident that it has been a profitable investment. The first year this distribution was made, the employees thought it a windfall that surely would not continue, and no particular results were noticeable.

Money in Their Own Pockets

Reactions at the end of the second year were not very different, but as the years passed and the windfall continued regularly, a distinct improvement has been noticeable. The employees have become more interested in their daily tasks, are sure of their jobs, and have come to realize that every saving they can make means cash to them.

Costs as a consequence have been reduced. Much of the saving may be attributed to engineering improvements, but scrap and salvage reductions attest to worker participation. Whereas supervision found it advisable in the early years to coach employees in the importance of spoiled work and cost reduction, it is now found that the older men voluntarily assume this task in training the younger employees.

As One P. D. to Another

JOHN RICHELSEN
Personnel Director
Vanadium Corporation of America
Niagara Falls, N. Y.

WE PERSONNEL DIRECTORS of small industrial plants don't often get the chance to put on our halos and stage a parade for ourselves. This magazine is kind enough to the thousands of us in industry to let us tell the world, on this page, how good we really are. And while we're telling it we hope the members of our boards of directors are not going to tune out our brief broadcast.

Doctor, Lawyer, Diplomat

The few simple requirements for a good personnel director, as our experiences have taught us, are merely that he should be a trustworthy and sympathetic father confessor, a fairly good lawyer, a lay doctor, a practical nurse, a student of psychology, and a master diplomat. These are some of the primary requirements for his job.

The personnel director interprets the management to the men, and the men to the management. If he is merely a stooge for the management, he has no influence over the men; if he is so engrossed with the employees' viewpoint that he cannot appreciate the difficulties and economic limitations of management and transmit them to the men in terms of their own understanding, he is of little use to his company. He may be neither a front office yesman nor a one-sided labor man.

If the personnel director has the right temperament for it, he has a swell job. If he hasn't the temperament, it's hell and he'd better get himself transferred to the sales department before his mind caves in on him. Happy is the personnel director who has a well-poised management to work for, who believes in the great value of his job for contemporaneous social betterment, and who can walk with kings (i.e., the big shots of his industry) "nor lose the common touch."

We listen to our men's troubles. We go to their homes. Occasionally we've got to keep husband and wife from beating each other up. Our ears became confessionals for the sins of men. And that's our spiritual functioning.

Merchants and loan sharks slap garnishments on our men's pay checks. There are eviction notices, tax problems, mortgage foreclosures, group insurance puzzles, and compensation questions. We've even got to have a smattering of legal knowledge at our finger tips.

The first aid department is under our care, and so we are petitioned for help and advice touching all the ills that human flesh is heir to. Clergyman, lawyer, doctor we are, to the extent of our knowledge and ability.

Even a fair-to-middling good p.d. in an industrial establishment cannot possibly expect to get a salary commensurate with what he is worth to the men and to the management. He'll have to get his reward in other kinds of pay. This isn't a squawk. It's a feeble evaluation of the p.d.'s job, written by a p.d. for the p.d. If we tried, we might possibly be able to uncover some shortcomings among us, perhaps smug professionalism, maybe sometimes a tendency toward snootiness, but we shall reserve our heart searchings for our group meetings and not wash our underwear in public.

Rates the Cowboy's Epitaph

The good will and loyalty of the employees under our supervision constitute two big factors in industrial success and human advancement. The attainment of these goals is largely in our hands. Working amid the discordant elements of clashing human nature, striving for the best possible and practical adjustments in an economic world as yet far from being a Utopia, a fairly good personnel director in modern industry is entitled to the cowboy's epitaph when he passes to his reward:

"I fit a good fight,
I done my damdest,
Angels could do no more."

When Wiring Your Plant

Switching, protection, and grounding deserve close study. Upon them largely depend safety of men and machines, and reliable service

F. L. AIME
Electrical Engineer
Anaconda Wire & Cable Company
New York

GENERAL PRINCIPLES discussed in several preceding articles, governing the layout and installation of primary and secondary distribution systems, apply equally well, of course, to the installation of lighting systems. Nevertheless, much of what could be said about their layout is beyond the scope of these articles.

Planning of industrial lighting systems is a rather specialized field in which many factors outside of purely electrical matters must be taken into account. Location of machines and workplaces, features of building construction, and the intensity of illumination required largely determine the kind and size of lighting units needed, spacing and mounting heights, and so on. Various factors may dictate the most suitable switching arrangements. These requirements should be fixed before starting to lay out the system.

It is worth while to say that lighting systems should be carefully planned and provision made for a reasonable future increase in intensity by using conductors of ample size.

Another point to remember is that factories of any size should have some sort of emergency lighting, at least for exits, supplied from an independent source which will be available in the event of power failure. Storage batteries are frequently used for this purpose. They need not be large, since comparatively small lamps can be used for exit lights. Another method involves the use of a waterwheel connected to the city water system and driving a generator that has a rating of, say, 500 watts.

In any event, the emergency supply should be arranged to come on automatically after failure of the regular supply.

It All Depends on Design

Switching and fusing arrangements for all circuits are worthy of careful study in any plant, large or small. Safety and reliability depend to a great extent upon switches and fuses.

The question of choice between automatic switches and fuses is principally one of economy, and has to be decided in each case after study of the requirements. In some plants switching and protective arrangements are entirely inadequate; in others too much money has been spent on them. A good designer will find a middle-of-the-road position, and follow it to everyone's advantage. Haphazard planning of switching and fusing will almost certainly lead to trouble.

In designing wiring layouts many special cases arise for which no definite rules can be given. Among these are circuits carrying heavy currents, such as those that supply welding machines and electric furnaces. The capacity of such circuits will range from a few hundred to as much as 75,000 amp., and special engineering is required to lay them out properly. Since all of these installations almost invariably differ in important details, each case must be treated individually.

The problem of bus design for these jobs is also a special one because it is practically essential that the regulation from the transformer to the unit be a minimum, and that there be no undue heating and no excess amount of copper used, hence no excess cost of bus and accessories. The design of this type of circuit should not be attempted by anyone unfamiliar with it.

A good example of the necessity for proper design in large-capacity circuits is found when several single-conductor cables are operated in parallel on a three-phase circuit. If these cables are improperly arranged with respect to each other the circuit can be highly inefficient. When more than two cables in parallel are used the amount of current carried by the remaining ones can be quite small; in fact, actual experience shows that some may carry none at all.

Another example comes up in the design of bus comprising structural shapes, such as angles or channels. In such installations ventilation can be wholly inadequate instead of good, and it is quite possible to run the cost of fittings up to as much as four times the minimum necessary, if the designer lacks familiarity with them and their costs.

Ground for Safety

Proper grounding is the next important step to which attention must be directed. The subject of grounding can logically be divided into two parts:

1. Preventing live parts from becoming grounded.
2. Providing good ground connections wherever they are needed for the electrical circuit, and for the protection of life and property.

Objectives sought under item 1 can be attained by providing adequate insulation or spacing, or both, and giving the necessary protection from mechanical damage, heat, chemicals, and so on. This subject has been considered in detail in previous issues.

The second question presents one of the most important matters in

any electrical installation and deserves more detailed discussion, particularly with reference to industrial wiring.

In general, it can be said that the purpose of a ground connection is to prevent excessive voltages from developing on any portions of the system or on elements, such as machine frames and transformer cases, that are not intended to carry any current at all.

Keep Resistance Low

Why should certain points of an electrical wiring system purposely be connected to ground? One of the most important reasons for doing so is to provide protection against lightning or similar unusual surges which may occur during switching and possibly bring about excessive voltages or high frequency. Actually, no part of the wiring system carrying potential is directly connected to ground; the connection is made through a lightning arrester which, in its simplest forms, is an airgap. Normal voltage on a system cannot jump across this gap; hence no current flows. During a lightning or other high-frequency surge, however, there will usually be a sufficiently high voltage to bridge the gap and thus discharge the surge to ground before any damage can be done to apparatus or wiring. This is the principle of operation of lightning arresters.

The path to ground should be as straight and simple as possible, and non-inductive. A high-frequency surge will discharge through a marble slab more easily than through a few turns of wire. Thus, when iron pipes are used as grounds it is a waste of time and money to run a copper wire inside these pipes because the discharge would not take place through the wire at all, but along the surface of the pipe.

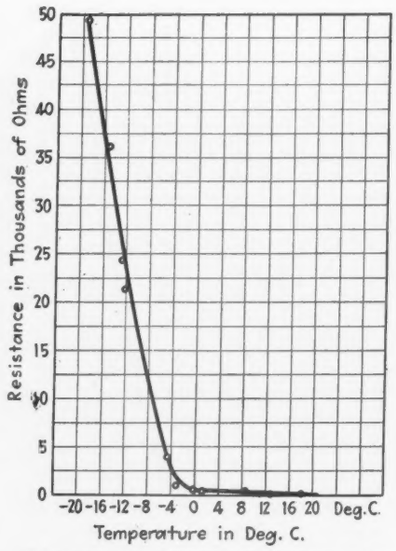
Ground wires should be connected to the pipes or other grounding means as solidly as possible, and with as close to zero resistance at the connection point as can be obtained. In addition to being non-inductive, the path to ground should be as low in ohmic resistance as possible.

One exception to the statement that ground resistance should be as low as possible is found in the case of large generators, motors, or transformers where it is frequently necessary to provide a resistor or an inductor in a neutral ground circuit to limit the ground current to a predetermined value. But even here the connections to ground itself should be of low resistance so that the only resistance or inductance in the neutral circuit is that which is purposely connected, and of known value.

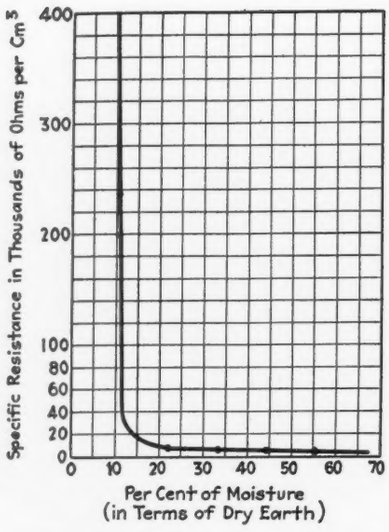
Frames of machines and instruments should be well grounded to prevent any excess voltage charges from accumulating on them.

With a few exceptions, one pole of the secondary winding of each potential and current transformer should be grounded for safety, as shown in the wiring diagrams in

(Continued on page 148)

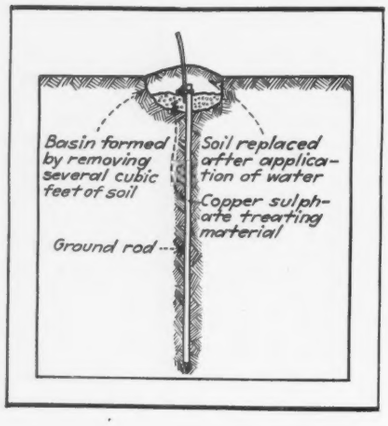


Temperature has an important effect on the resistance of soil, in this instance a particular type of clay soil having 18.6 per cent of moisture. Ground rods should be driven well below the frost line. Source: Technologic Paper No. 25, U. S. Bureau of Standards



If soil contains less than about 22 per cent moisture, the resistance increases very rapidly. It is also necessary that sufficient mineral salts be present to form a conducting electrolyte. Source: Technologic Paper No. 25, U. S. Bureau of Standards

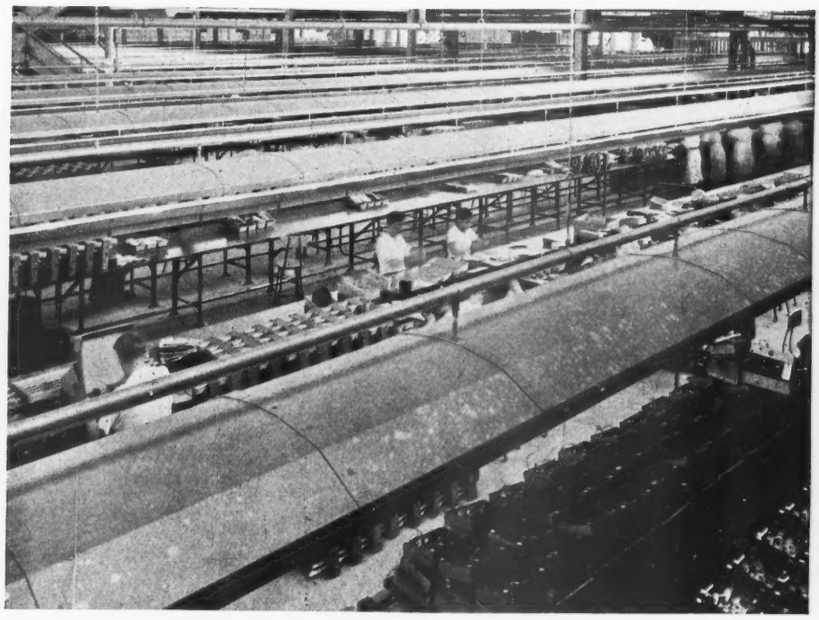
This is one of the simplest methods of reducing resistance of soil by treatment with a salt that forms a conducting solution


Basin formed by removing several cubic feet of soil
Soil replaced after application of water
Copper sulphate treating material
Ground rod

Resistance of Different Kinds of Soil *

Number of Grounds Tested	*Soil*	*Resistance, Ohms*		
		Average	*Minimum*	*Maximum*
24	Fills, and ground containing more or less refuse, such as ashes, cinders, and brine waste	14	3.5	41
205	Clay, shale, adobe, gumbo, loam, and slightly sandy loam with no stones or gravel.....	24	2.0	98
237	Clay, adobe, gumbo, and loam mixed with varying proportions of sand, gravel, and stones.....	93	6.0	800
72	Gravel, sand, or stones with little or no clay or loam.....	554	35	2,700

* *Technologic Paper No. 108, U. S. Bureau of Standards*



Lighting the Lines

With 40 foot-candles of uniform, glareless light—a 100,000-watt installation

J. F. ANDREWS
Assistant Editor

TO GAIN THE BENEFITS of correct lighting—more production, fewer mistakes, elimination of strain on operators—the Galvin Manufacturing Company decided to light-condition its new Motorola radio plant, and installed 2,150 feet of Curtis "Light-Hood."

Forty foot-candles of uniform, glareless, practically shadowless light are now measured on the working surfaces of assembly tables and laboratory benches, while 15 foot-candles reach the aisles.

No More Eye-Strain

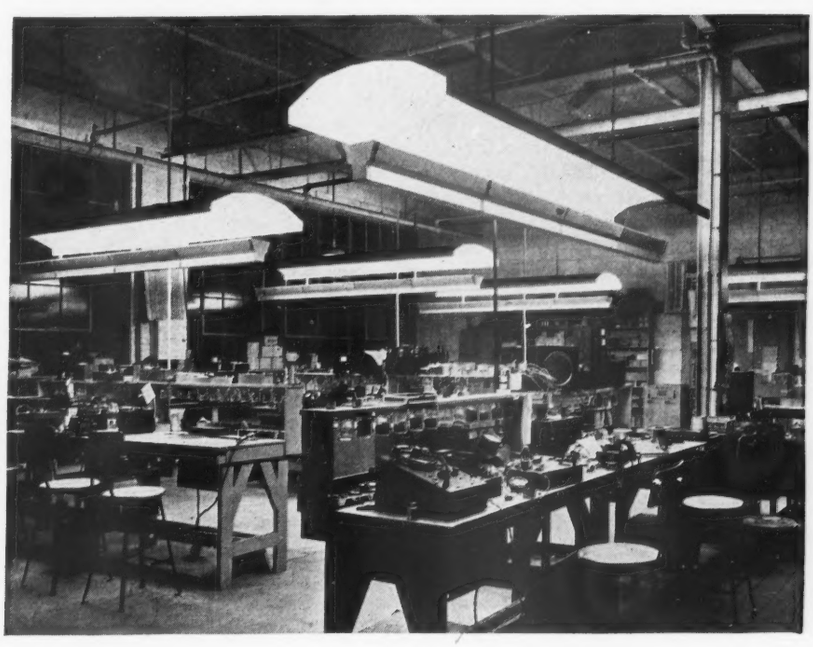
The lines are installed sufficiently high above the tables so that employees cannot see the bare lamps.

Great demands were made on whatever equipment was to be selected in this case. Uniform lighting for five 125-ft. assembly lines, five 90-ft. assembly lines, and five 10-ft. laboratory benches was needed. It had to be of high intensity to insure accuracy and speed in assembling small parts of the radio chassis. It had to be glareless and shadowless, allowing no reflections from the metallic material. It had to be easy to maintain.

Lower part of the equipment selected consists of an aluminum reflecting trough mounted on a wiring channel. The upper part is a steel hood shaped and treated to produce an efficient reflecting ceiling. The 150-watt lamps are installed on 30-ft. centers.

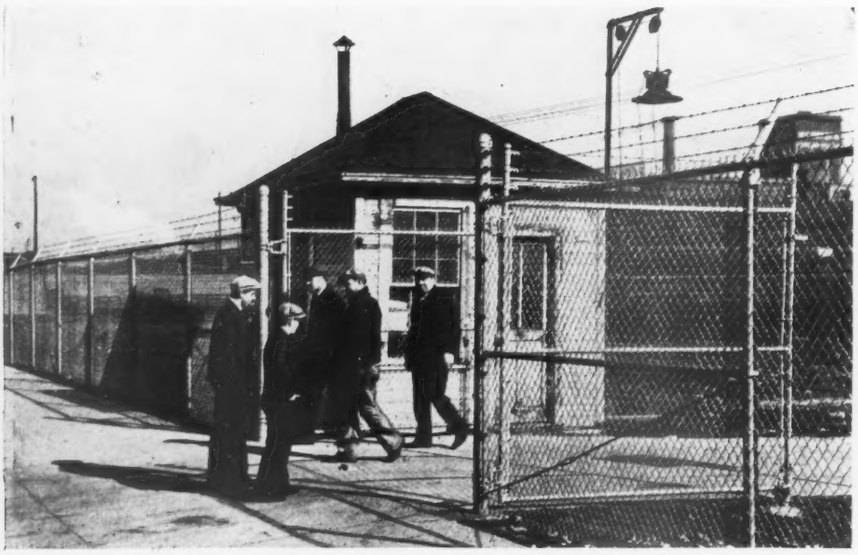
A pipe batten hung from wood beams at the ceiling furnishes main support. Lockweave chains of 1,200 lb. tensile strength were dropped on 14-ft. centers from lag bolts driven into these beams, and carry a 1½-in. pipe from which the lighting lines are hung by pipe straps placed 5 ft. apart. Turnbuckles at lower ends of the chains make it possible to level the equipment.

Individual circuits are provided for each of four lights in the line. They are controlled from panelboards mounted near the lines on the roof support posts.



Looking down (top photograph) on "Light-Hoods" suspended along the assembly lines

Ten-foot units mounted over laboratory benches give plenty of light for fine work



Three strands of barbed wire at the top of a fence are enough to discourage the most hardy

Putting Up a Fence?

A poorly built fence may be better than none, but for maximum service and life, it must be tailored to the needs, and properly erected

W. H. BLEECKER
Page Fence Association

FENCING may be regarded as the outer garment of the factory yard. In order to discharge its functions properly it must be tailored to the exact measure, to surface contours, to prevailing atmospheric conditions, to protective requirements, and to the expected life. Such tailoring requires expert study and specification. Each fencing problem differs in some respect from all others.

The average or typical factory protective fence is metal chain link, 7 or 8 ft. in height, topped by three strands of barbed wire held by extension arms attached to metal fence posts. These arms may be either vertical or slanted inwardly or outwardly to hold the barbed wire at an angle.

Chain link factory fencing may, however, run from 3 to 18 ft. in height. It may or may not be topped with barbed wire. Any one of four different metals may be chosen for the most effective resistance to destructive atmospheric conditions. The fence may be made of wire ranging from the lightest gage up to almost ¼ in. in thickness. Or it may be a combination of all these various constructions, depending on the requirements at various points in the boundary line.

Chain link fabrics are 2-in. mesh, woven from No. 9 or No. 6 gage wire. Posts are of metal, which may be of wing-channel, H-beam, or tubular shape set at 10-ft. intervals to a depth of 3 ft. in bell-shaped concrete. The concrete "bell" resists lift and side pressure. It is usually domed slightly above the ground to shed water away from the post metal. Proper erection is indispensable to fence stability and requires expert attention.

In the matter of gates, there is the choice of four types: walk, swinging, sliding, and double-swinging railroad gates. Gates may be situated anywhere in the fence line. Great care must be taken, however, to anchor and brace all gate and end posts firmly, because the fence-fabric tension begins and ends at these points.

Some Metals Last Longer

It is important that careful attention be given to the metal from which fencing is made. Research has done a great deal to increase the life of the metal used in fencing; some metals have much longer life than others under the various destructive atmospheric conditions peculiar to different localities. Such conditions include salt spray, alkali, and acid or other chemical fumes—which are often carried long distances in the air from neighboring bodies of water or chemical plants.

Any consideration of chain link

metal fencing for factories should include a study of local atmospheric peculiarities and the selection of the metal that is most resistant to any destructive condition discovered. In many installations such a precautionary study of air conditions results in adding many years to the effective life and appearance of the fence selected.

Which Is Most Economical?

In general, copper-bearing steel fencing protected by a sufficient weight of zinc galvanizing is the most economical chain link for fencing in localities favorable to its use.

Various methods, including hot-dip and electro-galvanizing, are used by different manufacturers in the application of the protective zinc coating, but the most important considerations in purchasing concern the thickness, evenness, and weight of zinc applied and bonded to the basic metal.

Former standards of zinc application required from 7/10 to 1 oz. of zinc coating per square foot of wire. Leading fence manufacturers today, however, have set 1.2 oz. of zinc coating per square foot as the minimum requirement for effective protection. Some recommend up to 2.4 oz., double the minimum.

Aluminum woven wire fencing combines to a high degree corrosion resistance, strength, low maintenance cost, and high decorative value. Its light weight (approximately one-third the weight of steel) also results in a considerable reduction of weight on the supporting structure.

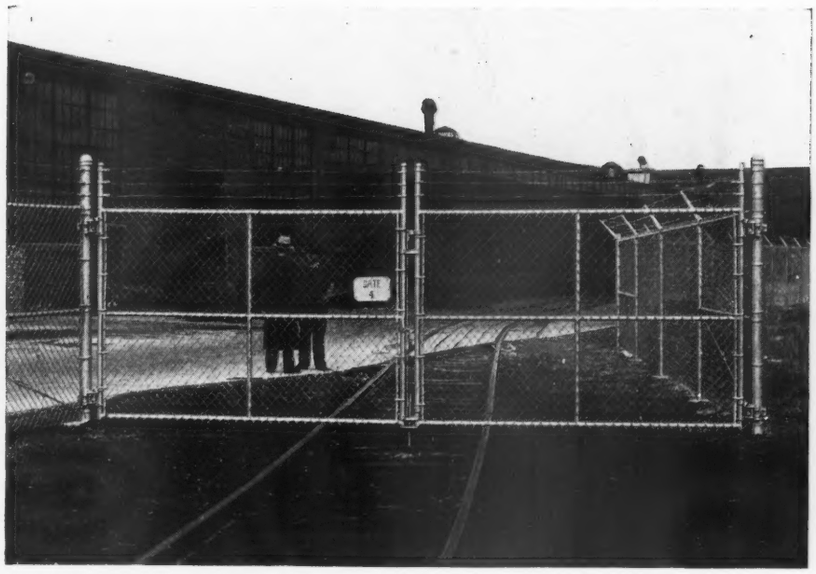
By reason of its corrosion-resisting qualities it is not necessary to protect aluminum fencing with any exterior coat, such as paint or galvanizing, which eliminates the necessity for periodic painting after erection and reduces maintenance cost to a minimum.

Stainless steel is another fence metal that possesses distinctly superior qualities. Fencing made from it possesses much beauty, is immune to rust and therefore needs no protective coating, and has a tensile strength four times that of low-carbon steel. For this reason it is possible to use much lighter gage stainless steel wire because fencing made from it will be equal in strength to much heavier fencing.

In view of the widespread trend toward stainless steel construction, its use might well be considered for any contemplated factory fencing installation, especially since its cost has been brought down to little more than that of galvanized, copper-bearing steel.

Galvanized ingot iron fabric, which costs a trifle more than the ordinary steel variety, provides another type of time-tested, corrosion-resisting fence suitable for many installations.

Recommendations as to the selection of one of these fencing metals for any particular installation is a matter for an expert to determine after examining all conditions pertaining to that installation.



Gates in fencing may be any desired size. Here railroad gates guard the entrance of a siding

Skillful Erection Important

Selecting styles, heights, trimmings, gates, and other details are all a matter of meeting requirements and individual tastes.

The skill with which a fence is erected determines to a great degree its effective life.

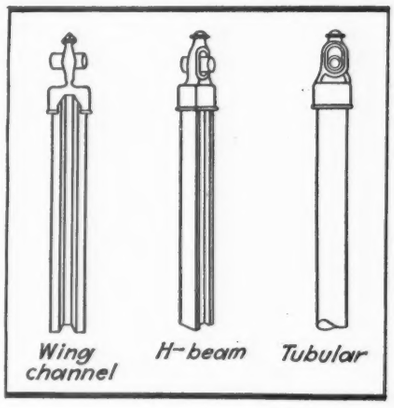
When these conditions are properly met, the resultant fence should afford satisfactory protection to factory and grounds for many years.

Protection of certain sections of building interiors is often as important as protection on the outside. Chain link metal fencing is particularly effective as protective partitioning for stockrooms, store-rooms, tool rooms, and other special departments.

Standard panel units are available which make for quick and flexible installation of such partitioning. These panel units are usually made 4 x 8 ft. in size, and are woven of No. 10 galvanized wire, with meshes 1½ in. square. Each panel is provided with legs which give a 3-in. floor clearance. When higher inclosures are required standard panels without legs may be placed in a horizontal position above the line of 8-ft. sections. In the event that ceiling clearance is not sufficient to permit use of the standard 4-ft. panels, it is possible to obtain panels 1, 2, or 3 ft. wide.

Such inside partitioning affords real protection, is fireproof, permits complete visibility and ventilation, and has 100 per cent salvage value, because panel partitions may be removed to other locations as often as necessary. Either sliding or swinging gates can be used, equipped for padlock or with tumbler lock arrangement as desired.

Metal posts for chain link fencing may be had in three different shapes



If Circuit Breakers Can't Take It

When short-circuit currents exceed breaker interrupting capacity watch out for fireworks and delays that will play hob with production

W. G. McDONALD
Industrial Division
Westinghouse Electric & Manufacturing Company
Philadelphia, Pa.

SOMETIME AGO a large industrial plant experienced a serious outage and consequent loss in production due to the failure of a number of oil circuit breakers caused by a short circuit on the system. Investigation indicated that these circuit breakers, when installed a number of years ago, had been entirely adequate for the short-circuit current that could be delivered in the event of a fault. However, this plant like many others has grown in the past 20 years with the result that the short-circuit current increased to the point of exceeding the rupturing capacity of the breakers.

This is a matter that is very easily overlooked by many industrial plants, inasmuch as its seriousness is brought home only when a short circuit occurs and it is found that the breakers are inadequate to clear the fault. Damage to equipment, possible loss of life, stoppage of production, and decreased profits result.

Much is being done to modernize plants and equipment, and bring them up to desirable standards of efficiency. It is necessary at the same time to consider the adequacy of the switchgear. This equipment serves as a safety valve and unless it is of suitable rupturing capacity it will fail in its function of safely interrupting the circuit in the event of a fault.

How it comes about that switchgear which was entirely satisfactory when installed may become potentially dangerous, or at least unsuitable, even though it is still in good condition will be apparent from the following discussion.

Consider the case of a new plant constructed in 1916, at which time the power company recommended for the incoming line an oil circuit breaker having a rupturing capacity of 15,000 amp. at 2,200 volts. This figure represented the short-circuit current that could be delivered at that time in the event of a fault.

Since 1916 the industrial growth of the locality has required that the size of the transmission line be increased and an additional bank of transformers added which has increased the short circuit current to, say, 30,000 amp. The result is that the incoming line breakers, although satisfactory for the conditions that existed in 1916, are totally inadequate for 1937 needs. If a fault occurs the old breakers are likely to fail, damaging equipment and possibly endangering life.

Let us assume that a plant built in 1922 was supplied from a 5,000-kva. bank of 13,200/2,200-volt transformers having 5 per cent reactance. The short-circuit current delivered by this bank, based on sustained primary voltage, would be 100,000 kva. Breakers were selected to meet these conditions, but due to the increase in production an additional bank of 5,000-kva. transformers has been put in parallel with the existing bank.

Twice the Kva.

The short-circuit current would now be 200,000 kva. and unless the bus structure were sectionalized so that the breakers would be subjected to the short-circuit current of one bank only, those that were installed

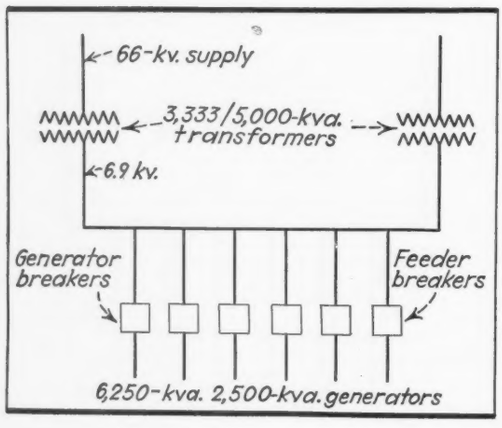


Figure 1. Layout of power supply system in a steel mill that formerly generated its energy, now purchases it

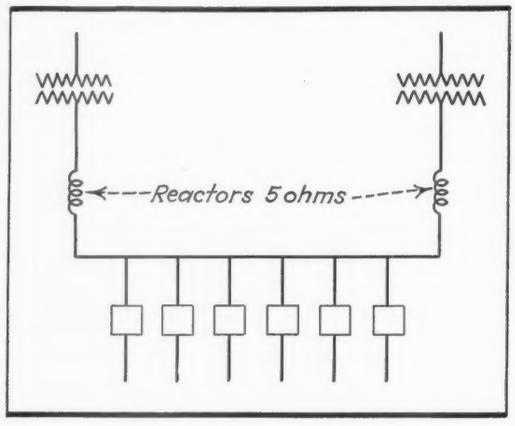


Figure 3. Voltage drop would be excessive with this arrangement of current-limiting reactors

in 1922 would be inadequate. If it were desired to operate the two transformer banks in parallel without sectionalizing the bus, it could be done provided larger breakers were installed to handle short circuits, or current-limiting reactors could be installed ahead of the old breakers to limit the current to 100,000 kva., on a short circuit.

The same conditions outlined above would hold true for a plant generating its own power. The generator breakers are usually non-automatic so that it is necessary to consider only the maximum safe current capacity for a short time. The feeder breakers are automatic and open on short circuit; hence, there is a chance of their being inadequate if an additional turbo-generator is added without sectionalizing the bus, or using current-limiting reactors.

No Longer Adequate

Addition of transformers or generating equipment requires a study of the short-circuit conditions to determine the rupturing capacity of the breakers required for the new operating conditions. In some instances additional equipment is installed without any thought being given to the effect that a short circuit would have on the existing circuit breakers.

Recently a large steel mill had occasion to make a study of the short-circuit conditions, since the breakers installed in 1918 had proved inadequate from a rupturing standpoint. This mill previously generated its own power but at present purchases all of it from a utility. Figure 1 shows a single-line diagram of the system.

The total short-circuit kva. from the two 3,333/5,000-kva. transformers having 10.68 per cent impedance, 5,000-kva. rating would be:

$$Kva. = 100 \div 10.68 \times 5{,}000 \times 2 = 93{,}000.$$

The total short-circuit kva. from the connected synchronous apparatus (motors and converters) based on 6,200 kva. would be:

Assume 22 per cent sub-transient reactance for synchronous motors, 4,200 kva.

Assume 25 per cent sub-transient reactance for synchronous converters, 2,000 kva.

Synchronous motor reactance (6,200-kva. base) = 22 × (6,200 ÷ 4,200) = 32.5 per cent.

Synchronous converter reactance (6,200-kva. base) = 25 × (6,200 ÷ 2,000) = 77.5 per cent.

$$\text{Resultant reactance} = \frac{1}{\frac{1}{32.5} + \frac{1}{77.5}}$$

$$= 22.9 \text{ per cent}$$

Reference to decrement curves for three-phase shorts on three-phase systems will indicate that the short circuit current as represented by synchronous apparatus of 6,200-kva. total capacity, based on a resultant reactance of 22.9 per cent and 0.15 sec. (breaker opening time) would be:

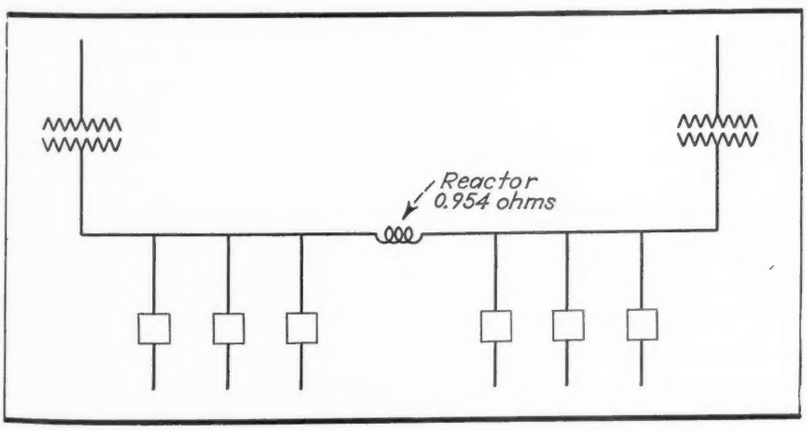
$$6{,}200 \times 4.1 = 25{,}450 \text{ kva.}$$

Short-circuit kva. will then be:

From transformers	= 93,000
From synchronous apparatus	= 25,450
	118,450

In the event of failure of one bank of transformers or an interruption in service caused by outage of the incoming line, it will be desired to operate the existing 6,250-kva. turbo-generator in parallel with the remaining bank of transformers. On a short circuit, transformer kva. = (100 ÷ 10.68) × 5,000 = 46,500.

Connected synchronous apparatus kva. = 6,200 × 4.1 = 25,450.



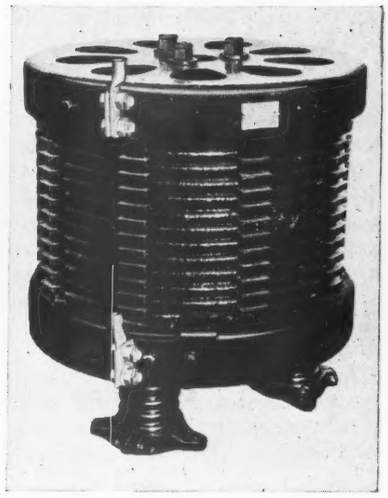


Figure 2. Short-circuit currents can be limited by using reactors

With 6,250-kva. rating at 9 per cent reactance and 0.15 sec. breaker opening time the turbo-generator short-circuit kva. will be 6,250 × 9.1 = 56,875.

Therefore the total short circuit kva. will be 46,500 + 25,450 + 56,875 = 128,825.

More Power Now

When the original switchgear was installed the rupturing capacity of the breakers was adequate, because at that time all of the power was generated by the one 6,250-kva. and a 2,500-kva. turbo-generator. Now all of the power is purchased. It will be noted that the short-circuit kva. has increased as follows:

Previous conditions:

Turbo-generators	= 79,600
Synchronous apparatus	= 25,450
	105,050

Present conditions (normal operation)

Transformers	= 93,000
Synchronous apparatus	= 25,450
	118,450

Present conditions (abnormal operation)

Transformer	= 46,500
Synchronous apparatus	= 25,450
Turbo-generator	= 56,875
	128,825

Figure 4. In this instance sectionalizing the bus through a reactor would not reduce short-circuit current below the interrupting capacity of the breaker

At the time the original installation was made the synchronous apparatus load was not so great as at present, with the result that the short-circuit current from this source was lower, with reduced duty on the breakers.

In the nineteen years that intervened, breaker ratings have been revised to the point where the present-day rating of the original breakers from a rupturing standpoint is considerably less than the former rating.

These breakers would probably have a present-day rupturing capacity of approximately 50,000 kva., based on the OCO-2-OCO duty cycle.

Reactors Can Often Be Used

Use of current-limiting reactors, Figure 2, will be considered in the solution of this problem, because in some cases their use offers an economical way out, without the necessity of replacing the existing breakers.

Referring to Figure 3, which shows the first arrangement,

$I = (5{,}000 \times 1{,}000) \div (6{,}900 \times 1.732) = 418.4$ amp. at full load.

Short-circuit current of one bank $= (100 \div 10.68) \times 418.4 = 3{,}920$ amperes.

Rupturing capacity of breakers, based on 50,000 kva., three-phase, 15,000 volts is $(50{,}000 \times 1{,}000) \div (15{,}000 \times 1.732) = 1{,}920$ amp.

Rupturing capacity of breaker at 6,900 volts $= (1{,}920 \times 15{,}000) \div 6{,}900 = 4{,}175$ amp.

Short-circuit kva. of synchronous apparatus = 25,450 kva.

Assume that it is desired to limit the total short-circuit current of the transformers to $50{,}000 - 25{,}450 =$ 24,550 kva. total or 12,275 kva. each.

$I = (12{,}275 \times 1{,}000) \div (6{,}900 \times 1.732) = 1{,}028.$

Reactance ohms at 4,180 amp., $X = E \div I = 6{,}900 \div 4{,}180 = 1.65.$

X ohms at 1,028 amp. $= 6{,}900 \div 1{,}028 = 6.7.$

X ohms required to limit current to 1,058 amp. $= 6.7 - 1.65 = 5.0.$

Per cent reactance, X, required $= [(5.0 \times 418.4) \div 3{,}980] \times 100 = 52.7.$

It is apparent that the use of a reactor of 52.7 per cent reactance would be impracticable in this case, since the drop across the reactor with normal load of 418.4 amp. at 90 per cent lagging power factor would be:

IX drop $= I \times X \times \sqrt{3} \times \text{sine } \phi = 418.4 \times 5.0 \times 1.732 \times 0.4358 = 1{,}580$ volts, where

I = Current in amperes
X = Reactance in ohms
$\sqrt{3} = 1.732$
Sine $\phi = 0.4358$, which is equal to an angle whose cosine is 0.90.

An alternative arrangement of reactors is shown in Figure 4. The total short-circuit kva. of transformers and synchronous apparatus is $93{,}000 + 25{,}450 = 118{,}450$ kva.

$I = (118{,}450 \times 1{,}000) \div (6{,}900 \times 1.732) = 9{,}911$ amp.

$X = 6{,}900 \div 9{,}911 = 0.696$ ohms.

$X = 6{,}900 \div 4{,}180 = 1.65$ ohms.

X required $= 1.65 - 0.696 = 0.954$ ohms.

Per cent $X = [(0.954 \times 418.4) \div 3{,}980] \times 100 = 10.03.$

This scheme of sectionalizing the bus through the use of a reactor would be practicable except for the fact that the short-circuit current of one transformer bank plus the portion of synchronous apparatus connected between the reactor and transformer would exceed the rupturing capacity of the breaker.

Both of the schemes described will serve to show how current-limiting reactors can oftentimes be used to keep short-circuit currents within the rating of the existing breakers. In the case under study, use of reactors is impracticable and the only solution is to replace the original breakers with others of 150,000-kva. rupturing capacity, the nearest standard rating.

An Individual Problem

In general, the factors that determine whether reactors can be used are the allowable voltage drop across the reactor at full load, losses, and cost. Each installation should be considered as a separate problem and the solution should be based on sound engineering and economic principles.

Where parallel operation of transformers or generators is not essential it is possible in many cases to keep within the rupturing capacity of existing breakers by sectionalizing the bus, or arranging the feeder breakers so that the fault current will not exceed their rating.

It is advisable to make a study of short-circuit conditions in a plant every five to ten years or, in the case of a rapidly expanding plant, every time that the capacity is increased.

In order to determine whether the incoming line breaker has sufficient rupturing capacity for present-day requirements, assuming that power is purchased, it is necessary merely to consult the power company. Power systems change constantly, due to system growth and other factors; therefore, it is necessary to consult the power company, unless one knows the source of power, interconnections of the system, and the circuit constants, in which event the short fault current can readily be calculated. If there has been no change in the primary circuit, but transformer capacity has been added, the new value of short-circuit current can be calculated in the manner shown.

Development in circuit interruptors has been so rapid that the rupturing capacity of many existing breakers can be greatly increased by rebuilding them. This work is being done at present by many large industrial plants and central stations, at a saving of thousands of dollars over the cost of replacing breakers.

When Pipe Lines Freeze

THAWING FROZEN water pipe lines by passing a comparatively heavy current through them has several advantages which other commonly used methods lack. Among these are elimination of fire hazard and the ability to treat inaccessible portions of the line.

A portable arc welding generator is an ideal source of the low-voltage current required. The generator terminals should be connected through suitable cables to opposite ends of the frozen section. Sufficient current must be passed through the pipe to create enough heat to melt the ice within a reasonable time—say, an hour or so.

Strength of current permissible is limited by the rating of the generator or by the amount that can be put through the pipe line without injuring fittings and joints. For efficient operation of the machine, pass current through a sufficient length of pipe to give approximately the rated voltage. Current flow should not exceed the rating of the generator, except for short periods.

Current values and length of time required to thaw a frozen pipe may vary considerably under different conditions. In general, a current of 30 amp. through a ½-in. pipe, 60 amp. through a 1-in., or 170 amp. through a 2-in. pipe will thaw them in about an hour. With brass pipe current values required are: ½-in., 45 amp.; 1-in., 85 amp.; 2-in., 200 amp. Copper pipe requires about twice as much current as brass pipe.

Same Power, New Drives, Doubled Output

Production had to be almost doubled with the same power consumption; so they cut losses to a whisper with new transmission equipment

ARTHUR VAN VLISSINGEN
Consulting Editor

JOB MANUFACTURING and mass production do not differ only in the size of runs between setups. Inherent in mass production is the necessity to reduce costs to permit successful competition against other well-managed businesses. Likewise, while a job manufacturing business may or may not have a large total volume of output, the mass production plant must turn out a lot of goods to keep prosperous.

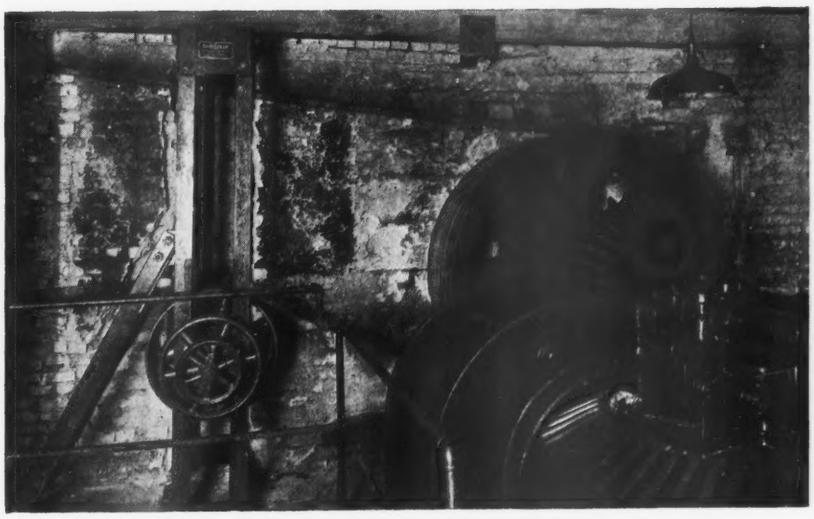
This is essentially the situation faced by a Wisconsin maker of woolen fabrics when the plant reopened after the depression. It had previously made cashmeres for suitings and overcoatings, in a wide variety of patterns. The new management saw a greater opportunity for continuing profit in the production of automobile upholstery fabrics for a far smaller number of customers. Plans were made accordingly.

More Machines, More Power

It soon became apparent, however, that the mill must turn out a considerably larger yardage in order to compete successfully. The old plant had done nicely on 40,000 or 50,000 yards capacity, but now it must produce from 75,000 to 90,000 yards to survive. And when it came to figuring out how to do it, the management came face to face with some major obstacles.

The plant would unquestionably require additional machinery. Since the buildings are very old, additional machinery would necessitate strengthening some of the floors. Moreover, it would take a lot more power. And the plant had always operated chiefly on water power, which meant that the power intake was dependent upon the waterwheel and the water available in the river. Increasing the waterwheel capacity was out of the question for a business just emerging from a three years' shutdown.

This is a statement of the principal difficulties which the Rock River Woolen Mills had to meet and overcome. The management brought in the engineering skill of outsiders, relying especially upon one maker of power transmission equipment. The upshot was a complete revamping of transmission equipment in the plant,



Belt slippage and loss of power from the waterwheel drive were practically eliminated by this oil-field-type belt tightener

a large increase in power delivered to the machines, a flexible layout which permits the most advantageous use of available power and the maximum output at the minimum cost for power.

Revamping started right at the waterwheel and went through to the machine drives. One sizeable economy came through installing a modern-type belt tightener, with handwheel control, on the main drive from the waterwheel. The tightener stopped a major power loss in the first stage of transmission, and cut to almost zero the former time requirements for belt lacing and adjustment.

Old J-type hangers were in use, and all bearings were grease-lubricated babbit, or ring oiling. The new shafting was mounted on roller-bearing hangers, cutting the friction loss greatly. The best available measurement of the difference in friction losses is that formerly, with the old-type bearings and with all drives disconnected from machines, it took all the strength of two men to turn over the main drive pulley on the second floor of the mill. Now the pulley which has taken its place can be turned over easily by anyone, using only one hand. At an estimate, therefore, the friction loss along this one lineshaft has been cut probably 85 or 90 per cent.

It seems safe to assume that a comparable reduction in power loss has occurred everywhere else in the plant where similar changes were made.

Part of the power saving has come also through the use of new, well-aligned shafting in place of the old, which was rather generally out of line. Most of the old shafting had been worn down at the bearings beyond the point of safety.

Cut-off couplings and clutches were put in at strategic points where they would afford a more flexible production setup. Thus whole sections of the shop may be cut off when their machines are not in use, or when there is insufficient waterpower available to run them. In every instance the clutch is mounted as close as possible to shaft supports, to eliminate shaft deflection. The mechanism side of the clutch is always placed so that it is idle when the clutch is disengaged. This permits easy adjustment of the clutch without shutting down the entire shop.

For example, power for the second floor group of machines is delivered through a drive from the main shaft of the waterwheel drive. But there are times when the second floor is not running the same shifts as the first floor; likewise times when water conditions in the river are wrong to permit driving to full capacity. Under these circumstances it is possible to cut off the upper floor with the clutch.

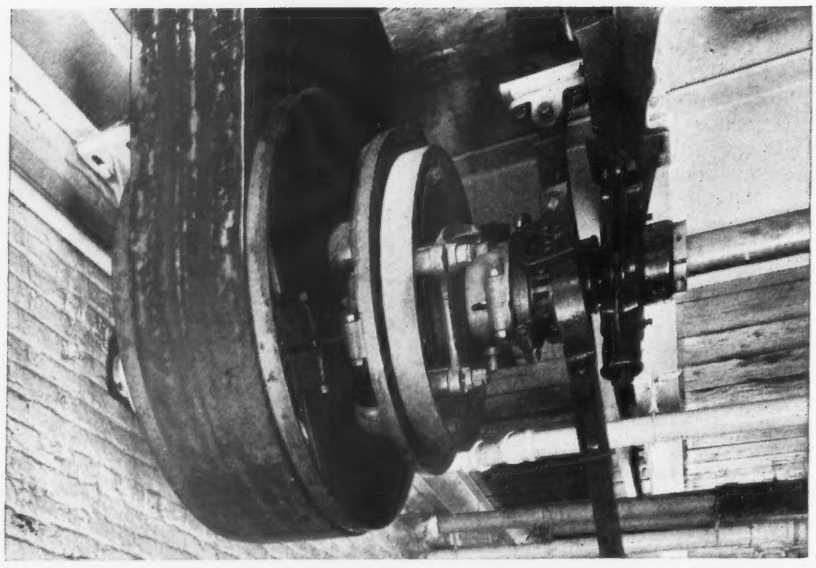
Switching to Motor Drive

Incidentally, this particular installation gives an excellent instance of the value of a split clutch. After the installation was made it was decided to put in this drive. Installing a solid clutch would have necessitated stripping the shaft of hangers, bearings, couplings, pulleys, and so on, to allow the clutch to be slipped on the shaft. The split clutch, however, was simply put in place and the two halves bolted together, after which a split cast-iron pulley was mounted on the sleeve.

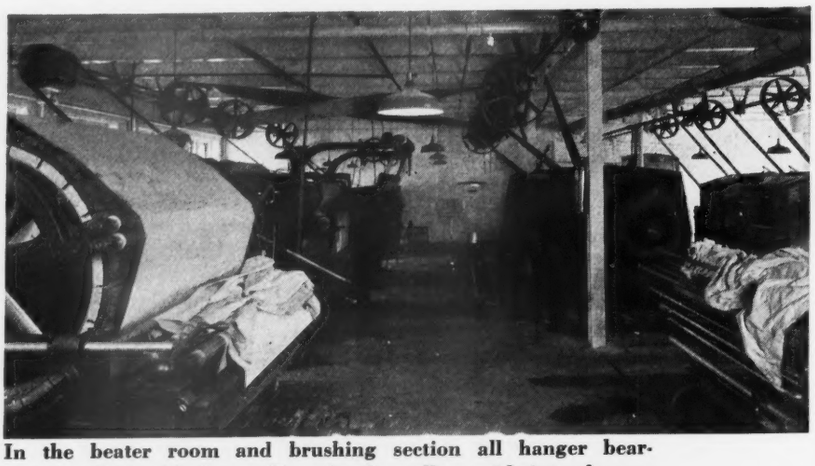
At first, the drive from the first to the second floor gave considerable trouble because of belt weave. This was remedied by installing a belt tightener on the second floor. The entire mechanism is covered by a sheet-metal housing to keep out dirt and lint.

Two-point ball-and-socket hangers are used on the main shaft in the finishing room and brushing section, and four-point cast-iron hangers on the lineshaft. On the second floor, four-point hangers are used throughout. Cast-iron and steel split pulleys with interchangeable bushings and compression couplings are also used,

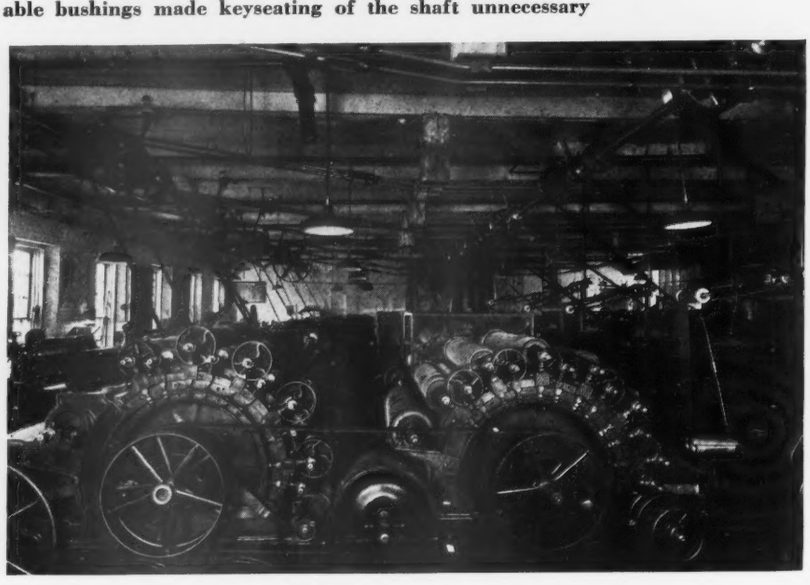
(*Continued on page* 154)



An easily installed split clutch permits shutting down the group drive on the second floor, whenever desirable to do so



In the beater room and brushing section all hanger bearings are Dodge-Timken. Use of split pulleys with interchangeable bushings made keyseating of the shaft unnecessary



Four-point hangers were used throughout the carding room on the second floor. Pulleys are split, cast iron or steel

In the New Electrical Code

New rules have been adopted, old ones changed, in the National Electrical Code to increase both the safety and the reliability of electrical services

A. B. SMITH
Assistant Director, Engineering Department
National Electrical Manufacturers Association
New York

A CONSIDERABLE NUMBER of changes have been made in the 1937 edition of the National Electrical Code. Many of these changes will affect industrial wiring practice and are therefore of interest to industrial plant electrical departments. In this article some of the differences in this respect between the 1935 and 1937 Codes will be pointed out. No attempt has been made to mention all of the changes or to predict the effect of any of them: only those changes which seem to be of the greatest importance have been noted.

Article 110—General

Section 112—Guarding of Live Parts—The voltage to be guarded has been reduced from 150 volts to ground to 50 volts. Special guarding is required only for live parts which would otherwise be exposed to contact; not for parts such as inclosed switches which have their own inclosures.

Article 200—Polarity Identification of Systems and Circuits

A new sentence provides that polyphase circuits need not have one conductor grounded and identified regardless of whether or not the supplying system contains a grounded neutral.

Article 210—Branch Circuits

The branch circuits of old Article 20 have been considerably revised.

New circuits are known as 15-, 20-, 25-, 35-, and 50-amp. branch circuits, and are those which supply more than one outlet. They are named by the maximum rating for the overcurrent protection, regardless of how large conductors may be for reduction of voltage drop.

There are various limitations for these circuits:

Medium-base lamps only on 15-amp. circuits.

Mogul-base lamps on any circuits.

Attachment plug receptacles ratings:

15 amp. for 15-amp. and 20-amp. circuits
20 amp. for 25-amp. circuits
35 amp. or more for 35-amp. circuits
50 amp. for 50-amp. circuits.

Conductors for polyphase circuits must be color coded (2104).

Number and type of circuits must be sufficient to supply at least the minimum load calculated on the basis (2107*b*) of 5-amp. for Mogul outlets, 1.5 amp. for others, and the full rating of fixed appliances. Loads are to be allocated to circuits in proportion to the circuit ratings (2108 and 2109).

The 35-amp. and 50-amp. circuits may supply only heavy-duty lamps or receptacle outlets for such lamps.

Common neutral (2113) may now be used for any of these five circuits. Any of them may be 3-, 4-, or 5-wire (2104) and must be color coded (2104).

The voltage to ground may not exceed 150 (2105).

Maximum rating of overcurrent protection for these circuits has been increased in some cases:

15-amp. circuits: 15 amp. for either 125 or 250 volts. Formerly allowed only 10 amp. for 250 volts. 35-amp. circuits: 35 amp. Formerly allowed only 20 amp. for 250 volts.

50-amp. circuits: 50 amp. Formerly allowed only 40 amp. for 125 volts, and 20 amp. for 250 volts.

Article 230—Services

Section 2351, with 2371, allow more liberal provisions for splitting up a large service. A service may now be divided into six or fewer feeders, each controlled by a switch or circuit breaker at the entrance. This is an increase of two feeders, and the former voltage limitation (150 volts to ground) is removed.

Under 2371, it is possible to have a main service disconnect and then split the service into six or fewer feeders each having its own set of fuses or circuit breaker. No individual disconnects are required.

Section 2353—Simultaneous Opening—Service switches on polyphase systems supplying power only for lights may be so arranged that each ungrounded line may be opened individually. There must, however, be provision that if the switch in the grounded conductor is opened, all ungrounded conductors will be opened along with it. (3801).

Section 2359—Service Equipment Grouped—This new provision would not require that all of the service equipment be grouped in cases where a separate service supplies emergency lighting, or where an additional service is installed because of capacity requirements, or because a building is of extremely large area.

Article 240—Overcurrent Protection

The 1935 Code provided that plug fuse bases installed after July 1, 1937, must be of the non-tamperable type. This has been changed to a permissive provision; the standard-type base may still be installed.

Article 250—Grounding

System Grounding—Certain d-c systems need not be grounded (2503) and a system supplying electric

Cranes operating over combustible fibers must not be a grounded one (2507).

Equipment Grounding—The equipment-grounding conductor of flexible cord may be bare (as formerly) or may be insulated, in which case the covering must be green (2560).

Grounding of equipment to the grounded conductor of the circuit is specifically recognized if special permission is obtained.

A No. 6 conductor used for grounding a system neutral or for grounding both the system neutral and equipment need not be in conduit or cable if it is so run as to be free from exposure to mechanical injury (2591*c*).

Article 300—General Requirements for Wiring Methods

Section 3012—A former recommendation has been made mandatory. Special protection must be provided for conductor insulation where conductors bear sharply on conduit bushings, etc. (3012*b*).

Section 3016—Bunched conductors, four or more in number, may be brought out of conduit, etc. through a single bushing; formerly this was limited to bunches of eight or more.

Article 320—Open Wiring on Insulators

Section 3209—Sleeves for passing wiring through thick walls or floors must now be of non-inductive material; formerly iron pipe was cited as suitable material.

Article 324—Concealed Knob and Tube Wiring

Section 3245—Conductor separation has been reduced from 5 in. to 3 in.

Article 338—Service Entrance Cable

Section 3382—Service entrance cable with the neutral conductor insulated is now recognized for additional use as feeders from a master service cabinet to supply other buildings, and as entrance conductors for such other buildings.

Article 346—Rig'd Metal Conduit

Section 3463—Some additional restrictions have been placed on steel conduit used in or under cinder fill, to guard against corrosion.

Section 3470—Running threads are prohibited.

Article 348—Electrical Metallic Tubing

Section 3482—Provision is now made for using electrical metallic tubing in or under cinder fill or cinder concrete, the same as for rigid conduit.

Article 364—Busways

Section 3648—Overcurrent protective devices may now be located where they are "not readily accessible" under certain conditions.

Article 370—Outlet and Other Boxes

Section 3705—Shallow boxes—The number of conductors in shallow boxes is now limited in a manner similar to the standard-depth boxes.

Section 3706 — If non-metallic boxes are used, the covers must also be non-metallic or else covered with non-metallic material. Screws for securing such covers must be specially located or be covered with non-metallic material.

Article 380—Switches

Section 3814—Snap switches controlling tungsten filament lamps must either be of the type having "T" rating, or else have a current rating equal to twice the lamp load they control. Switches having the "T" rating have that letter marked on the switch adjacent to the current rating.

Article 384—Switchboards and Panelboards

Section 3882—If supplied by feeders having overcurrent protection greater than 200 amp., panelboards must have main fuses or a circuit breaker rated not more than the panelboard rating.

Article 410—Fixtures, Lampholders, Receptacles and Rosettes

Section 4105—Ungrounded metal receptacles and their cover plates may not now be installed where within reach from bathtubs or shower baths.

Ungrounded metal fixtures and lampholders may not be within reach from any grounded metal on the premises.

Section 4123—Flush and recessed fixtures must be so constructed or so installed that adjacent combustible material will not be subjected to temperature in excess of 194 F. (90 C.)

Article 422—Appliances

Section 4247—Appliances supplied by individual circuits must have overcurrent protection rated not more than 150 per cent of the appliance rating, regardless of how much larger the circuit conductors may be reducing voltage drop.

Article 430—Motors and Controllers

Section 4303—This embodies an important change. It makes mandatory the former recommendation that motors which are subject to accumulation of large quantities of dust or flyings must be of a type which will not overheat under those conditions.

Motor Duty—Definitions for continuous, intermittent, periodic, short-time, and varying duty are given in Article 100—Definitions. These are very important in connection with determining the size and protection of conductors for motor circuits and running protection for motors.

A few examples of these duties are given in Section 4312, but these are not the only ones. It seems probable that these definitions will result in some changes of practice in motor wiring and protection. The Code provisions covering motors used on continuous-duty service are much more stringent than for other duties. See Sections 4312, 4313, 4322, 4323.

Motor Overcurrent Protection—Continuous Duty

Section 4322—Paragraph *b* newly provides that manually controlled motors of 1 hp. and less which are out of sight of the operator shall be protected the same way as those which are started automatically.

Section 4330—Motor protective devices other than fuses must be rated at least 115 per cent of the motor-full-load rating. This, in conjunction with the provision (4322) that the rating of the overcurrent protective device shall not be over 125 per cent of the motor rating makes a rather narrow limit for selecting the rating of protective devices other than fuses.

Motor Circuit Overcurrent Protection

Section 4344—Protection for the motor and for the motor branch circuit may be obtained in a single device if that device complies with Section 4322. This is based on the use of time delay overcurrent protective devices.

Motors Over 600 Volts

Sections 4424 and 4425—While not new, it is more clearly set out that suitable fuses may be used as motor circuit protection and as disconnecting means on circuits not exceeding 300 amp. at 2,500 volts or less and 100 amp. at 7,500 volts and less.

(Continued on page 146)

"In 12 years, we have never had a battery failure with Exide-Ironclads"

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You want to know

and the editors will gladly tell you more about the things mentioned on this page

• INDUSTRIAL RELATIONS — proceedings of this year's Silver Bay conference, "Promoting Constructive Relations in Industry," have been published. (12701)

• SURVEY of labor law administration has shown what state and federal action on health, safety, and employment standards has been. Report is available. (12702)

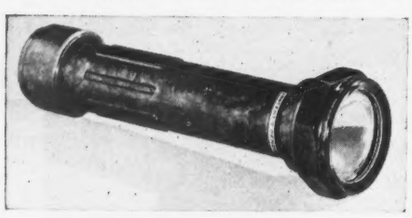
• WATER is made wetter with a new chemical which should find wide use in textile, paper, and other fields. Efficient in low concentrations, it can be used in hard water or acid solutions. Said to increase efficiency of metal cleaners, fire extinguisher liquids, and window cleaners. (12703)

• "MACHINING ALUMINUM" is a booklet which should be useful to many, because new uses and applications are constantly appearing for this metal. Part one of this revised edition is on general machining practice, part two on automatic screw machine work. Five useful tables are included. (12704)

• REVERSE MASTER COPIES for liquid hectograph duplicating machines can be made without handling the carbon paper by using a newly developed all-electric writer. It's said to save in operating costs too. (12705)

• PAINT for exterior use adheres solidly to brick, concrete, and all masonry surfaces. Its penetrating primer gets in around the rough particles, hides even porous surfaces in from one to two coats. (12706)

• BIBLIOGRAPHY of information on industrial relations lists in classified order articles and books published in the last four years on this all-important subject so much in the public eye today. (12707)



WATERPROOF and explosion-proof is this flashlight, with a hermetically sealed switch inclosed in the rotating knob at its base. This base controls focusing mechanism as well. Entire case is of impact-resistant plastic, lens of shatterproof glass. (12724)

• ETHICS and good business practices are surveyed in an important report about to be published, which calls upon business to adopt and maintain high ethical standards in dealing with customers, suppliers, competitors, employees, stockholders, creditors, local community, and government. (12708)

• CONTRAST of labor's standing in the United States and Great Britain as compared with the *ism* nations is shown in a booklet. (12709)

• ALUMINUM FINISH for high-heat applications resists temperatures as high as 1,400 deg. F., although best results come below 800 deg. (12710)

• TYPEWRITER, automatic, has dial-controlled selecting mechanism with which typist selects any of several letters or paragraphs perforated on a single record roll. Machine can be stopped to insert dates, names, addresses, or special matter. (12711)

• FACTS on machines, working hours, and the American standard of living are pictorially presented in a booklet which treats effect of mechanization on jobs, man-hours of work today compared to a generation ago, employment per unit of finished product. (12712)

• PLASTER made from volcanic ash has unusual heat-resisting qualities. In tests, walls one inch thick have been subjected to a flame temperature of 6,200 deg. F. for 15 min. without allowing heat to pass through. (12713)

• DID YOU KNOW that sterilized steel is now a regular product? The industry thus bows to the fellow whom health propaganda can't reform from using his mouth as a storage box for tacks and nails. After being tumbled in sawdust, and heated to destroy bacteria, they are packed in kegs lined with sterilized paper. (12714)

• 67,000 new manufacturing plants will be needed to provide jobs for available factory labor says a recent study entitled "What Can Industry Do About Unemployment?" (12715)

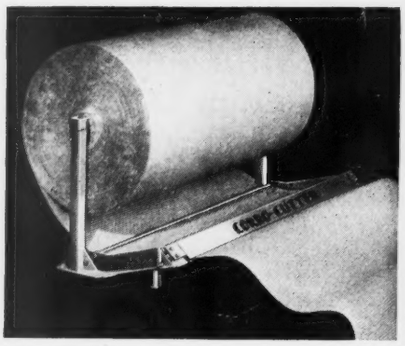
• GUM, synthetic, in liquid form, is said to withstand action of alkalis and hot or cold acids, nitric excepted. Applied by brush, spray, or dip. (12716)

• IMPROVED QUALITY and lower price in all things are manifestations of the blessing the machine is. According to a new booklet, not until machines were developed could we enjoy the full attainment of "life, liberty, and the pursuit of happiness." (12717)

• COATING for plating racks can be used in copper, nickel, zinc, cadmium, or silver plating at temperatures up to 220 deg. F. A synthetic liquid, it is applied by brushing, spraying, or dipping. (12718)

• DUSTS have come in for a lot of discussion because of industry's awareness of the dangers of silicosis. Important questions arising continually on the nature and effects of dusts are presented and answered in a booklet in simple and, in so far as possible, non-technical language. (12719)

• NUTS that automatically lock themselves and stay that way until unlocked with an ordinary wrench are just the things to use where unusual vibration or chance of shock exists. (12720)



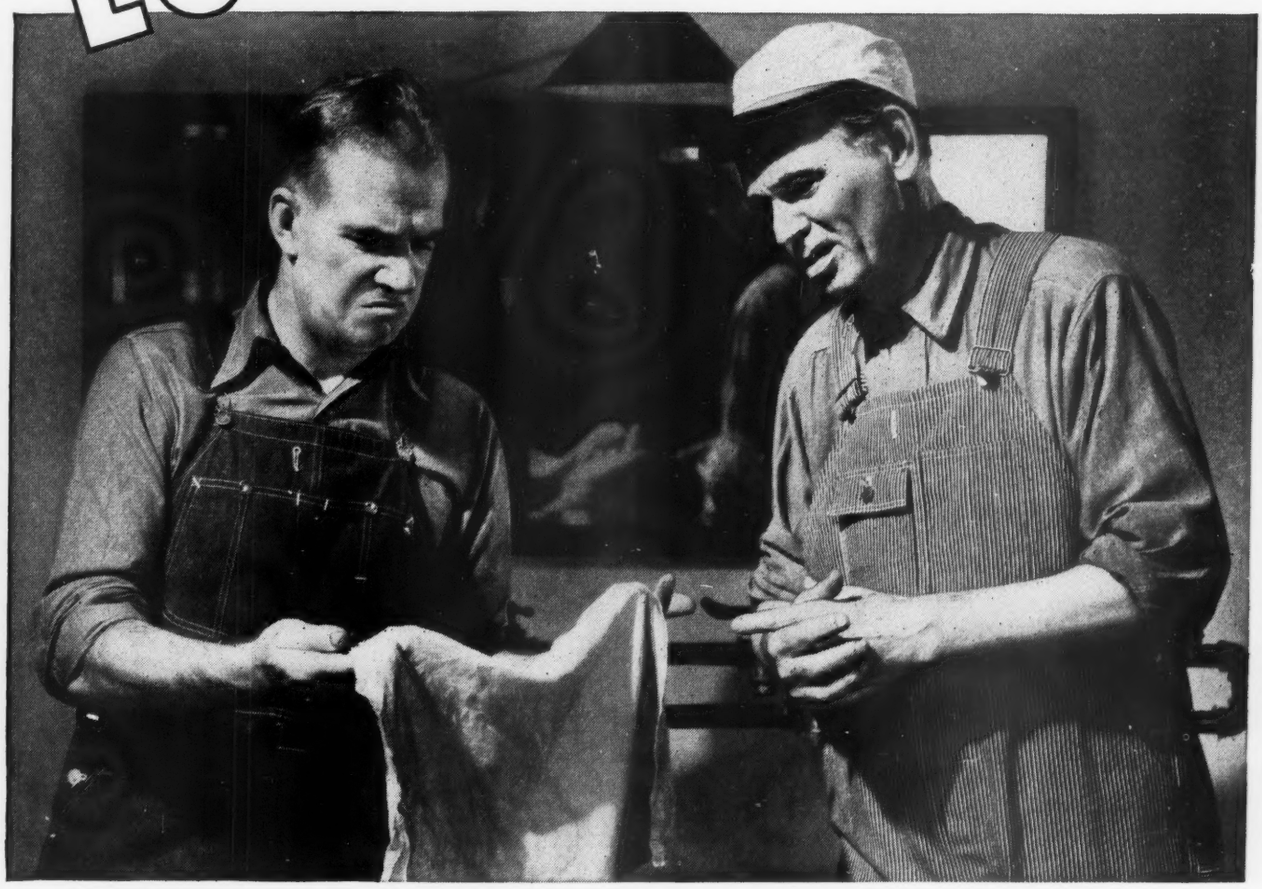
A LIFE of heavy service is what this flexible-corrugated-paper cutter expects. Of all steel construction, it can be assembled in five minutes, it is said. Fits all size rolls from 12 to 72 in. wide, and can be mounted on walls and on or under tables. (12725)

• THRIFT is a neglected virtue in American life, it is charged. A nonprofit organization will, with an employer's consent, come into his plant, help employees formulate individual savings plans, and arrange for savings bank, life insurance company, or post office representatives to enroll employees in whichever of these agencies they choose. Each employee adopting this method of saving authorizes the employer to divert a portion of his pay to the chosen agency. (12721)

• SEALING COMPOUND, plastic, for cracks and seams, may be applied in the same way as putty, will remain flexible at zero, and withstand a temperature of 350 deg. F. without melting and flowing. (12722)

• FLOOR-PATCHING MATERIAL for concrete floors can be walked on in 2 to 3 hours after application, will carry heavy trucks in 12. It is applied with a trowel after mixing with water. (12723)

LOST A $50,000 INDUSTRIAL-RELATIONS PROGRAM . . . *in an Unsanitary Washroom*



Daily grumbling . . . an undercurrent of discontent . . . annoying evidences of poor morale. Yet, plant equipment is modern; "welfare" programs are operating.

IF these conditions exist in your organization, a look into your *washroom* will often reveal the cause of the trouble. Does it meet *human* standards of comfort and sanitation? Do you supply really clean, comfortable towels?

A thoroughly equipped washroom makes satisfied, loyal workers. It pays worth-while dividends to employers in employee good will . . . in satisfactory industrial relations.

Insure proper cleanliness and health for *your* employees by providing soft, sanitary ScotTissue Towels. Individual towels, dispensed from immaculate cabinets . . . a new towel for each using. Economical, too, for special processing makes one ScotTissue Towel dry *drier, faster* than several ordinary towels.

Test their comfort and economy . . . free. Write for a trial quantity on your business letterhead. See how soft, pliant and thorough drying they really are! Scott Paper Company, Chester, Pennsylvania.

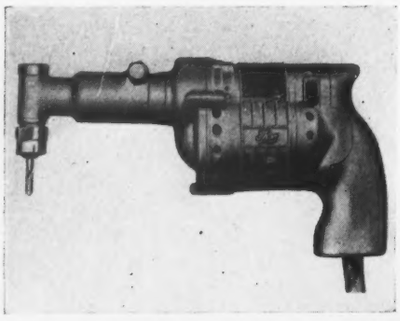
SCOTTISSUE, the same toilet paper that is preferred by more people than any other, is now available to large industrial users in Service-Roll form at surprisingly low cost.

Thirsty Fibre Really DRIES

ScotTissue Towels

BY THE MAKERS OF SCOTTISSUE, WALDORF AND SCOTTOWELS FOR HOMES

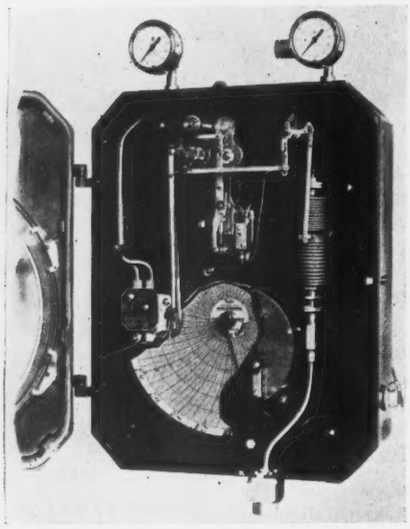
What's New in Equipment



Right-Angle Drill

Thor U14R right-angle drill in $\frac{3}{16}$- and $\frac{1}{4}$-in. capacities has working clearance of only $2\frac{3}{8}$ in. Drillhead measures only $2\frac{1}{8}$ in. overall and the angle attachment can be turned and clamped into any position. Weighs but 3 lb., and is but $9\frac{1}{4}$ in. overall. Equipped with collets for twist drills in sizes of $\frac{1}{16}$, $\frac{3}{32}$, $\frac{1}{4}$, $\frac{5}{32}$ and $\frac{3}{8}$ in. Can also be supplied with spindle to take $\frac{3}{16}$-in. chuck. Spindle offset is $\frac{13}{32}$ in. Operates at a speed of 2,700 r.p.m., but can also be furnished with speeds of 3,750 and 5,100 r.p.m. Independent Pneumatic Tool Co., 606 West Jackson Blvd., Chicago.

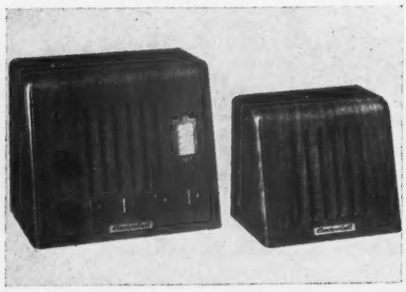
Instruments



Line of instruments for indicating, recording, and controlling absolute pressure. Absolute-pressure element consists of a flexible phosphor bronze bellows to the inside of which the pressure medium under measurement is communicated. Connected with this assembly and opposing its action is a second identical metal bellows which has been evacuated and sealed, thus comprising an atmospheric-pressure compensator. These instruments are applicable to distillation units, evaporators, condensers. Taylor Instrument Companies, Rochester, N. Y.

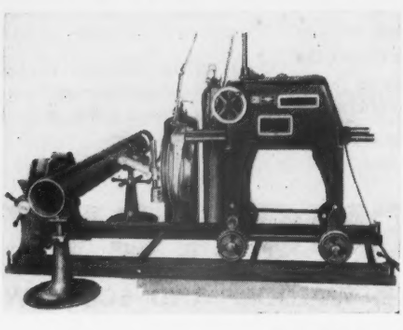
Communicating System

"Electro-Call" communicating system provides a two-way selective system. Three systems are available—two-, five-, and six-way. Model 302 consists of a single master and outlying station where only two-way conversation is necessary. This master can handle four outlying stations where selectivity of station is not required. Model 300-5 features a five-way selective master equipped to handle selective communication to five outlying stations. No selector switch is necessary. Model 305 permits simultaneous conversation between any pair of stations and is available in 4, 5, and 6 masters. United Scientific Laboratories, 510-518 Sixth Ave., New York.



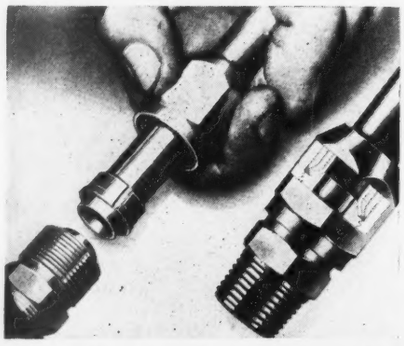
Pipe Machine

No. 512-A "Tom Thumb" portable pipe machine rounds out a line of $\frac{1}{2}$- to 2-in. machines. Diehead is integral with carriage and the threading dies are rigidly supported. Diehead is of the front-cutting type which, together with the machine's "close-grip" front chuck, makes it possible to handle pieces as short as $2\frac{1}{2}$ in. Internal oiling system for the dies and cutoff tool. Flexible hose carries oil from oil pump to intake valve in the diehead and the flow of oil is controlled by a two-way thumb valve conveniently located for the operator. Holder for the cutoff and reaming and chamfering tools is operated in a heavy block by a large ball crank. Overall length is 34 in.; width, 21 in.; height, 24 in. The Oster Mfg. Co., 2057 East 61st Place, Cleveland.

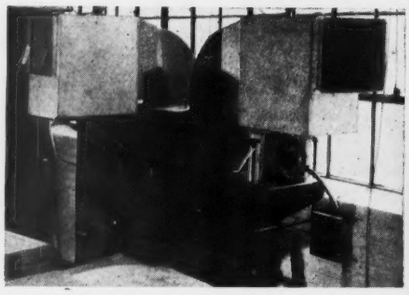


Tube Couplings

Self-flaring tube couplings are offered in a complete line, including a varied assortment of tees, elbows, and unions in all sizes. They can be applied at the job without use of flaring tools. There is no soldering or brazing to be done. After slipping first a swivel nut and then a split ring on the tube, the tube end is pressed up against the male connector. As the threads of the swivel nut engage the threads of the connector, the tube begins to flare after about two threads have been engaged. After the swivel nut is turned down a full flare is made and the connector seats tightly. It is claimed tube distortion, cracking, and split ends are avoided by use of this coupling. Packless Metal Products Corp., 37-14 29th St., Long Island City, N. Y.



Humidifier



The "Humidity Box" is a spray or fog chamber provided with suitable water filter and nozzles, air filter-eliminator or baffle, and drain fitting.. It is designed to introduce moisture into spaces warmed by unit heaters. Can be fitted to blower-type or propeller-fan-type unit heaters, or in any warm air current, whether in free air or in a duct. Supplied with or without fan or blower units. Can only be combined with heating surface inside the spray chamber. Where less than 30 lb. per sq.in. water pressure is available, an electric vaporizer may be used to secure atomization. The Air Conditioning Supply Co., 1893 East 55th St., Cleveland.

Group Showers

Multi-Stall Showers, both circular "5-In-A Group" and semi-circular "3-In-A Group" models are now available with stainless steel partitions. Made of 16-gage stainless steel with a tubular beading of

.06 CENT SAVED MEANS THOUSANDS OF DOLLARS EARNED

RECENTLY a manufacturer of a packaged food product found that by reducing the length of his carton flaps three-quarters of an inch he could save thousands in cardboard costs yearly. He was able to put that economy into practice because he was using Pneumatic equipment which, because of its more flexible design, could be readily adapted to this change. • Those Pneumatic machines cost him more to start with . . . but today he is saving money with every package they produce. When you buy Pneumatic machines you are buying "lower cost per container," and that is the cost that counts. Ask America's largest producers of packaged and bottled goods. The majority of them are Pneumatic users of long standing. In practically every field the leaders are Pneumatic customers. . . . Because Pneumatic machines are more versatile, depreciate more slowly, require less money and "time out" for repairs! • We'll gladly send dummy packages demonstrating the economy construction mentioned above.

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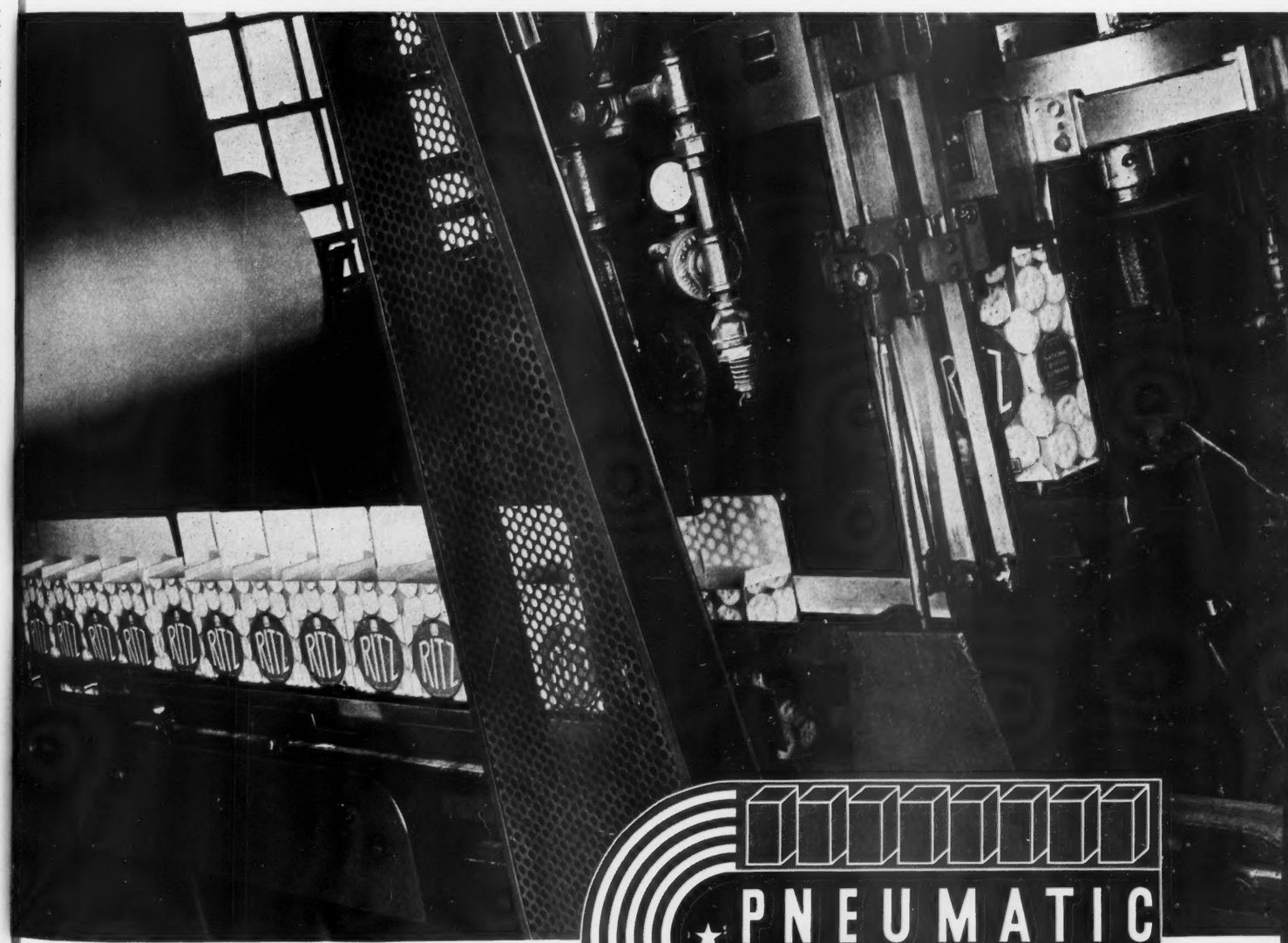

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ILES BISCUIT CO. · RALSTON PURINA CO. · WESTON BISCUIT
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EEBLER-WEYL BAKING CO. · HOROWITZ BROS. & MARGARETEN
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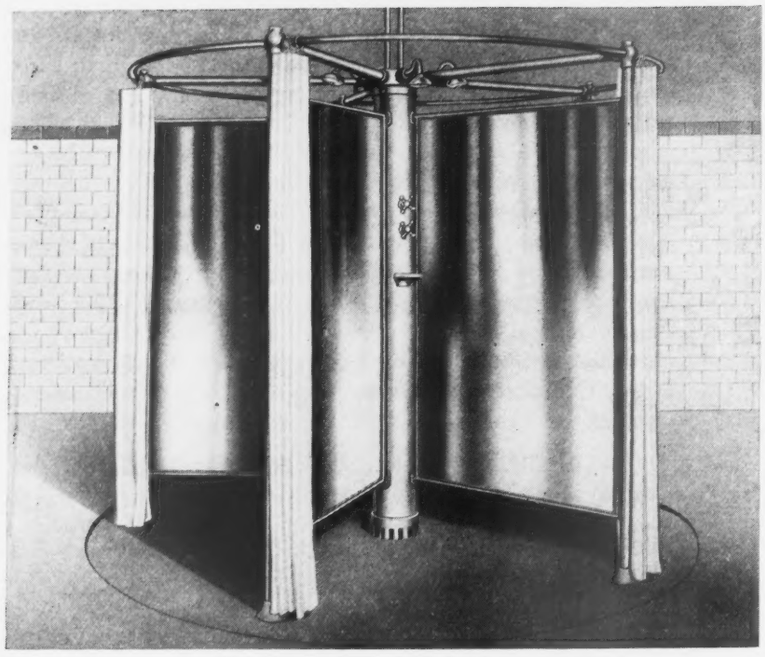


the same material. Chromium-plated brass fittings, and high-temperature, baked aluminum enamel approximating the color of the partitions covers the central standard and framework. Are quickly installed, only three plumbing connections being necessary. Said to be easy to keep clean. Bradley Washfountain Co., Milwaukee.

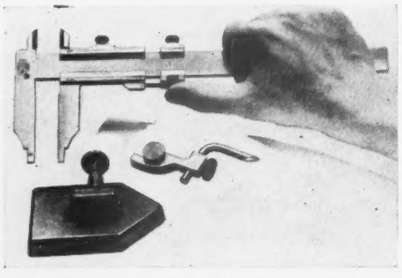
Welding Gloves

Welding gloves made of a specially tanned horsehide leather in combination with cowhide give gloves of great welding quality. Are very pliable and will not stiffen upon drying after immersion in hot or cold water. Long palms and short cuffs make the gloves comfortable. The Linde Air Products Co., 30 East 42d St., New York.

Pyrometer Controller

"Alnor" pyrometer controller is intended for automatic temperature control of heat-treating furnaces, melting pots, or other heating devices at a predetermined point. Principle of operation is electronic. Pointer of the indicating pyrometer carries a small vane, and an adjustable target is provided which carries two condenser plates or vanes. These vanes are the capacitive element of a tuned circuit. When vane of the temperature pointer approaches the target setting, it and the target interleave and produce a circuit change which in turn operates a relay. This relay operates electric heating element or fuel valve in the furnace. A red bull's-eye indicates whether furnace heat is on or off. Removal of front cover plate of housing exposes all binding posts for easy wiring. Six temperature ranges are available, one up to 3,000 deg. F., using thermocouples of different types. Illinois Testing Laboratories, Inc., 420 North La Salle St., Chicago.

Calipers



No. 537 Mauser Calipers are graduated in 1/1000 and 1/128 in. Come in three sizes with measuring capacities of 7, 9, and 11 in. Base if attached by means of a screw and an accurately tapered center at the end of one jaw transforms this tool into a height gage. Vernier caliper has two knife edges which are practical for layout work; also for measuring distances between holes and for measuring root diameters of gears. The scribing attachment is a separate unit and may be attached to the upper jaw. Steel point of scribing attachment is adjustable. George Scherr Co., 128 Lafayette St., New York.

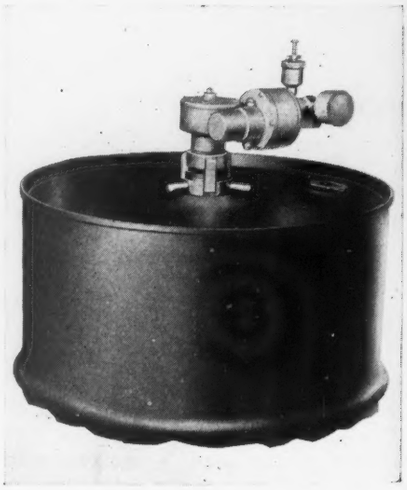
Hand Truck

Type A3 truck is for convenient and speedy handling of wood or steel barrels and drums from keg size to 36 in. high. Featured by an attachment device consisting of a hook and tongue member adjustably mounted on the vertical column. In operation, the tongue member is positioned about 1 in. above the lower edge of the barrel chime, while the truck is held against the barrel at both top and bottom. The hook is then placed over the edge of the barrel and the wheels allowed to roll back until the tongue slips under the lower edge of the chime. By means of the handle and pedal the wheels are pushed up to the load, which is raised off the floor and attached to the truck. It is then

tipped to balancing position and easily moved. Wheels are 10x3 in., mounted on roller bearings, and can be furnished with steel, hard rubber, or pneumatic tires. Axle is 1¼ in. in diameter and overall width of truck is 25 in. It is said one man can easily pick up and transport loads up to 900 lb. with this truck. The Sabin Machine Co., 6538 Carnegie Ave., Cleveland.

Drive

Air motor drive for agitators built integral in paint drums is a unit consisting of a standard air motor and a reduction unit. Included are two drivers, one for ½-in. square and one for ⅝-in. square on the agitator shaft. Drivers are threaded to fit the thread on the drive shaft. Adapter with 1½-in. and 2½-in. straight male thread,



FOR BETTER DRIVES

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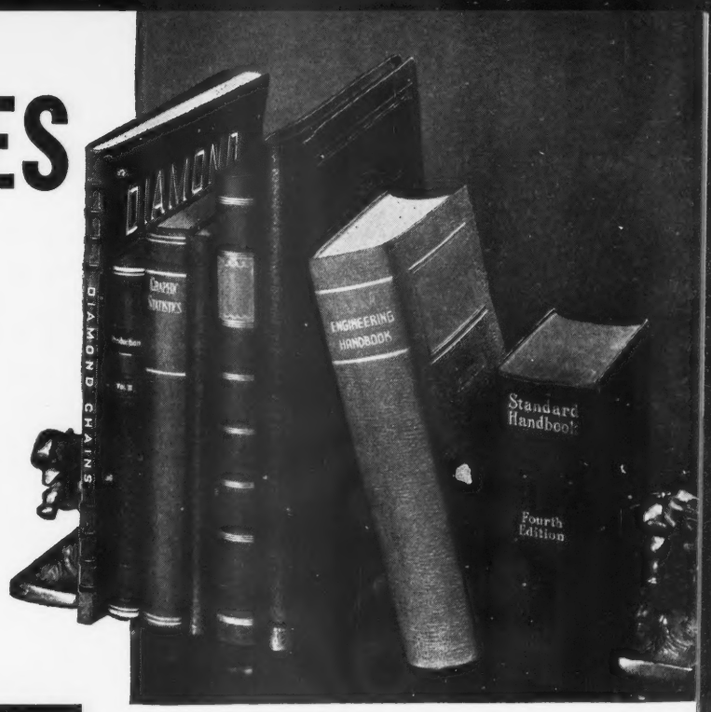

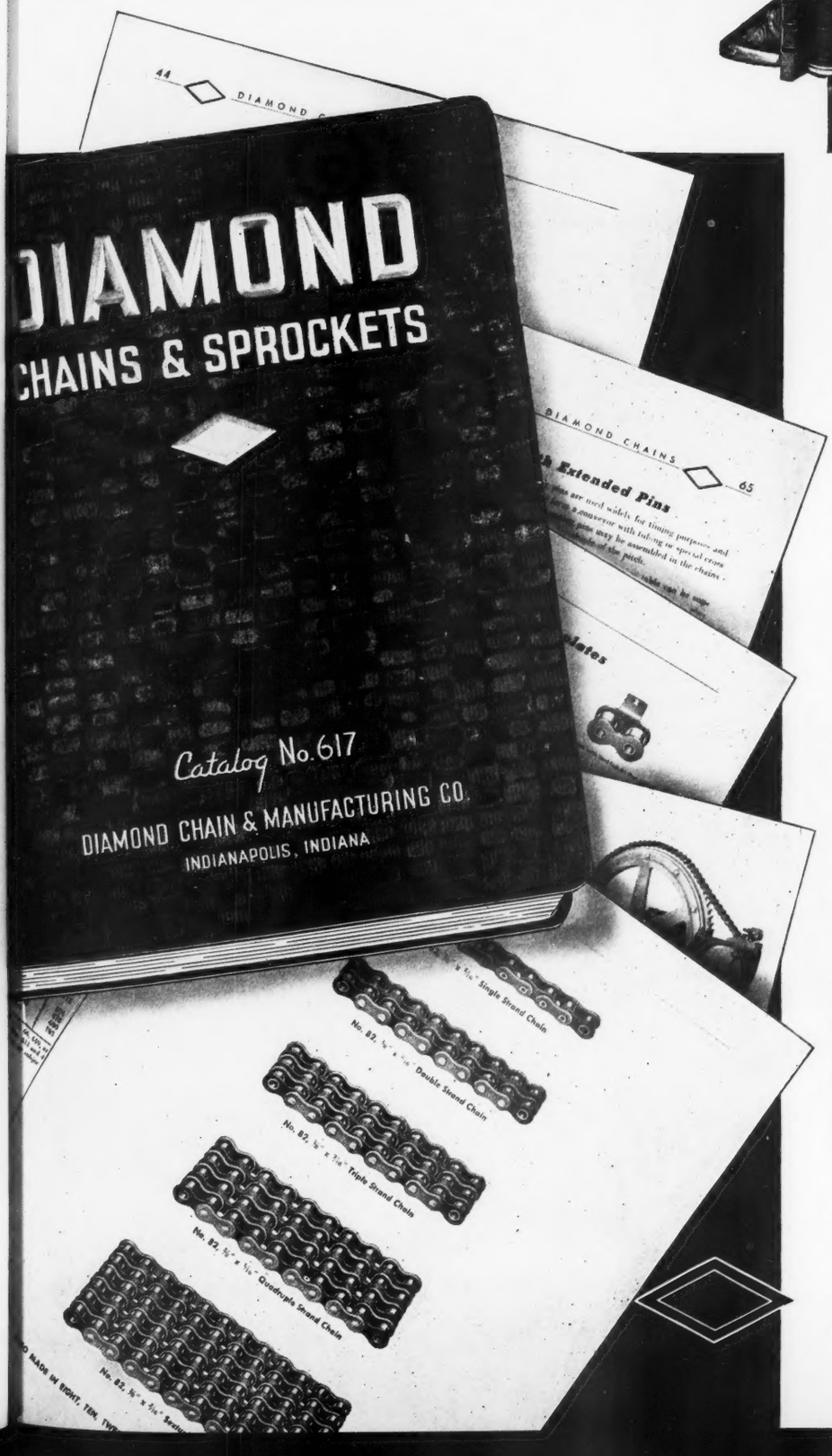

As a builder of machinery and a user of power drives in your plant, you will find this new 100-page Catalog valuable for its usable information on power transmission.

It points out how to make the best use of the higher efficiencies that Diamond Roller Chains afford . . . Extensive "worked-out" tables give the answers to drive problems of every kind, speed and capacity—more information than has been available heretofore.

Get this new book, study your drives—apply Diamond Chain for lower power costs, increased and maintained production output, and reduced maintenance . . . Diamond is used as regular equipment on machinery of leading manufacturers and for drives in plants of highest efficiencies (over 8,000 in one plant alone). Let us mail you a copy of Catalog 617. DIAMOND CHAIN & MFG. CO., 449 Kentucky Ave., Indianapolis, Ind. *Offices and Distributors in Principal Cities.*

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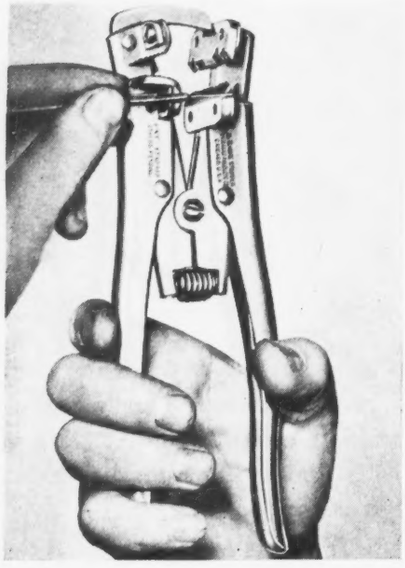
and 1¼-in. female pipe thread to fit the openings in the paint drums, is included. Unit is portable, may be transferred from one drum to another in a few moments time. Operates from a 1-hp. or larger air compressor, depending upon the speed of agitation required. Motor speed is adjustable from 10 r.p.m. up. The De Vilbiss Co., Toledo, Ohio.

Wire Stripper



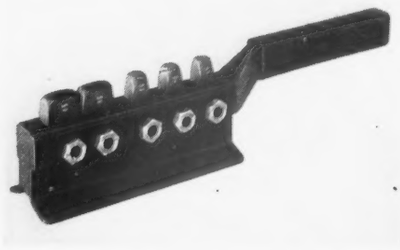
"E-Z Automatic" wire stripper has a lever at the top which stops the return of the arm until the wire is removed after stripping, then it is snapped quickly back to normal. Can be used for wire insulation 0.050 in. or larger. There are four models for wire from 8 to 30 gage. Number of stripping holes ranges from 2 to 6. After wire has been placed in stripper pressure on handles first cuts insulation. Continued pressure strips the insulation. Pyramid Products Co., 2309 South State St., Chicago.

Time Recorder

"Uni-Speed" time recorder is operated with one hand and is said to be speedy. Because of its speed of operation it reduces congestion in aisles where employees are checking in and out. Prints time on front of time card. Is fully automatic and tardy or irregular registrations may be printed in red. Made with black morocco finish and operates accurately under conditions of dust, dirt, and vibration. Stromberg Electric Co., 223 West Erie St., Chicago.

Pipe Marker

Holder No. 63 holds steel stamp in place while marking steel pipe, bar, cylinders, and other round objects. It prevents off-angle blows that make stamps fly from er's hands. When several stamps are used, the holder holds them in alignment.



It fits various diameters. Stamps used have the company's "Safe-Hed" and "Tuf-Face" features which are the result of special heat-treating and quenching. Stamps are grooved on one side and held in place by a turnscrew. Jas. H. Matthews & Co., 3942 Forbes St., Pittsburgh.

Lubricating Compound

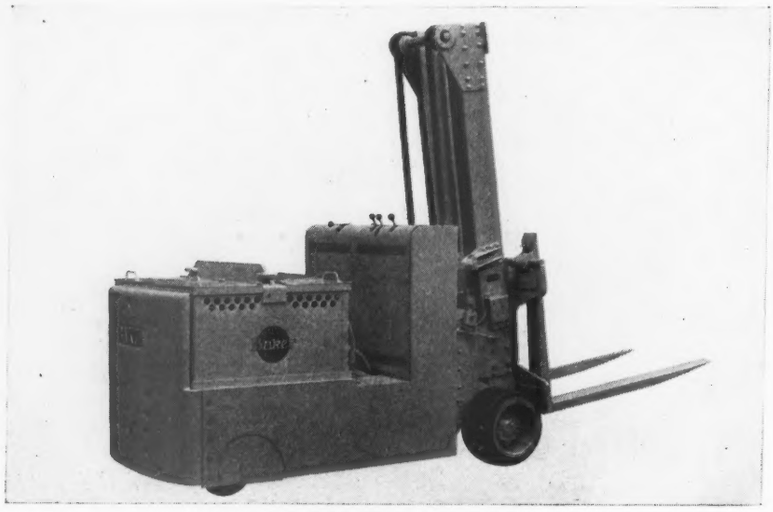
"Ball Roll" is a lubricating compound of jellylike consistency which is used in conjunction with oil or grease. It is introduced into the parts to be lubricated through the oil hole, grease cup, or other device. Upon dispersion throughout the lubricant, it forms a semi-fluid oily layer and prevents metal-to-metal contact, regardless of how thin the main body of the lubricant may become. It is said to practically eliminate starting wear. It contains no graphite, mica or other abrasives, and no acid-forming materials. Lubco Corp., 669 West Washington Blvd., Chicago.

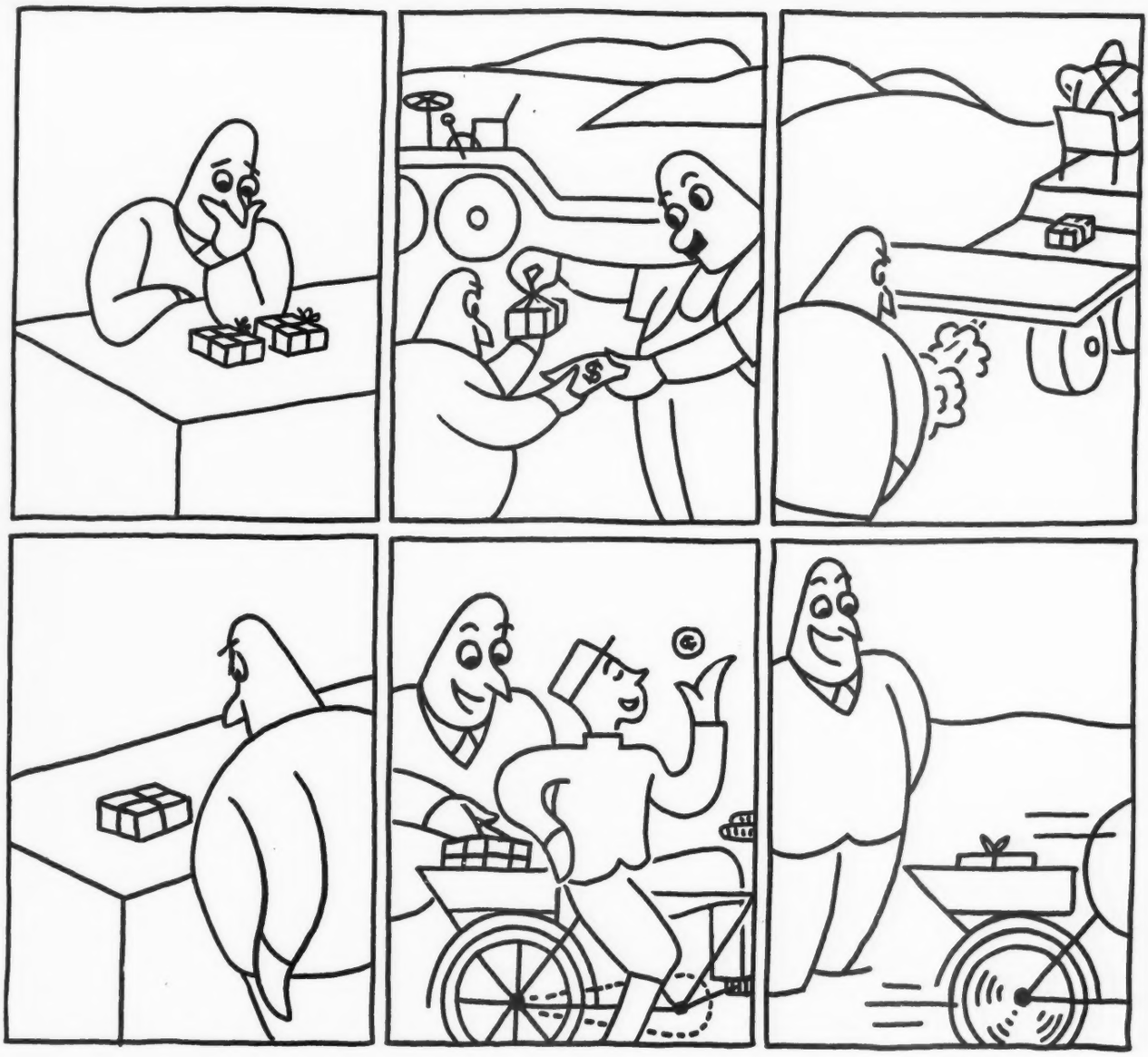
Drinking Fountains

Six drinking fountains made of vitreous china and sculptured in easy-to-keep-clean modernistic design. Three of the models are called the Erie line. One of these with integral strainer is equipped with two bubblers, automatic stream regulators, and self-closing valves and loose key stops. Other Erie fountains include a single bubbler with a pushbutton, self-closing ice water faucet, and a combination bubbler and ice water faucet with a glass receptor. The Ontario fountain with two bubblers is similar to the Erie except that it is of the roll rim type, supported on brackets. There are two fountains in the Oasis model. On these the supply and waste fittings are concealed in a housing to improve appearance and eliminate condensation. Both of these fountains have vitreous china backs, one 8 in. high, the other 15 in. high. Either one of these fountains can be had with ice water faucets if desired. The bubblers in all fountains are located above the rim to avoid back-siphonage. Crane Co., 836 South Michigan Ave., Chicago.

Trucks

Heavy-duty ram and fork trucks with capacity of 16,000 lb., wheelbase of 92 in., and weight of 18,000 lb. without battery. Power steer is provided so that it may be maneuvered easily. Has center control. Full contactor control is provided for all motors through mill-type, magnetic, blow-out contactors operated by small master controllers located conveniently to the driver. Three speeds in both directions, and anti-plugging feature to prevent reversal of the motor without bringing truck to a stop. Snap-action limit switches act as cutouts at both limits of the hoisting, tilting, and steering motions. Has dead-man control so that brake is set when operator leaves his position. Driving axle has two reductions, spiral-bevel and herringbone. Axle shafts are of heat-treated alloy steel, 2½ in. in diameter, and are full floating. Truck is designed so that





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all parts are accessible for easy maintenance. Disk-type hoisting, tilting, and steering brakes. Two independent systems of travel brakes — service and parking. Baker-Raulang Co., Cleveland.

Vapor-Proof Fixtures

Vapor-proof fixtures and reflectors come in four reflector types with three body styles—vertical, horizontal, and outlet-box types. They can be had in medium and mogul sizes. These fixtures are standard construction with green-enameled, cast iron threaded body, clear glass globe with threaded neck, and a porcelain-enameled reflector, green outside, white inside. Quadrangle Mfg. Co., South Peoria St., Chicago.

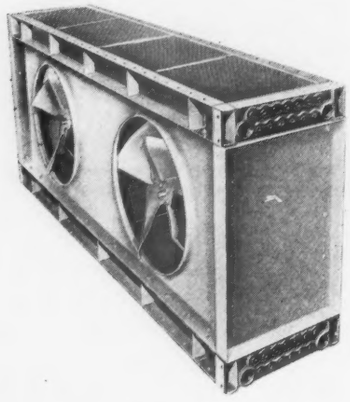
Metal Spray Gun

Model OZ-3 has gearshift. High speed may be used for spraying low melting point metals such as tin, lead, cadmium, zinc; low speed for aluminum, brass, copper, bronze and steel. Wire tension device is automatically controlled by movement of

gas control lever. The assembly is removable from gun body and available for inspection. High-capacity nozzle of two-piece construction has positive tapered seats. Shafts are mounted in self-lubricated ball bearings. Uses ⅛-in. wire for the various grades of steel. Stevens Metal Spraying, Inc., 83 Shipley St., San Francisco.

Multiple Unit Heater

"Multiple Projection Unit Heater" is a propeller-type heater with long-range delivery and large capacity. It is a high-velocity, multiple-fan unit with each fan under individual control. A ceiling-mounted unit, warm upper air is drawn through two coils and then projected straight downward in a vertical stream which reaches and stays on and near the floor where heat is needed. It is primarily designed for use where maximum space must be heated with a minimum of units. A single unit mounted at the ceiling in the center of the factory will take care of a huge floor area. Durably built for permanent service and consists of two extended surface coils contained within a sturdy metal casing. Motors are mounted out of the path of the air on a resilient construction. Employs four-blade propeller fan. Available with two, three, or even more fans. Unit can be mounted as high as 30 ft. The Trane Co., La Crosse, Wis.

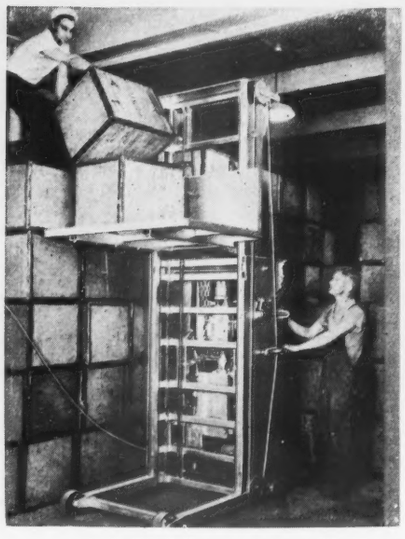


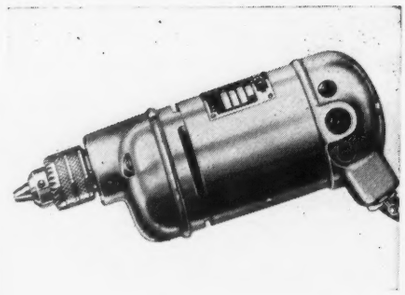
Marking Lacquer

Marking lacquer can be used on cellulose acetate and other similar molded plastics without chipping or scaling. Comes in black, white, and colors. H. V. Walker Co., Elizabeth, N. J.

Elevator

"Electric Lifter" provides vertical transportation for anything that can be stacked. It is of the hinged, telescopic type. Hinging permits the upper section to be folded over for easy passage through normal doors. Has selective cable control by which the platform can be stopped at any pre-selected height. Pushbutton control is also available. Has a 12-ft. lift but can be built to any specification to handle barrels, boxes, bales, or loaded trailers. The Service Caster & Truck Co., 434 Somerville Ave., Somerville, Mass.





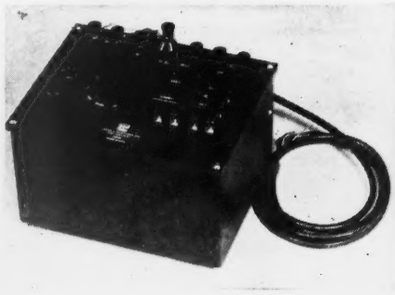
Drills

Electric drills in two sizes. Their compact design permits work in close quarters. Available in three different speeds for fast drilling metal, wood, or other materials. Gears are nickel steel, heat-treated. Ball bearing; aluminum alloy housing. No. 362 is $\frac{3}{16}$-in. capacity, has on-and-off switch mounted in rear end bell. No. 362H has automatic pistol-type handle and fully inclosed double-pole switch mounted in handle. No. 462 is similar to No. 362 with ¼-in. capacity. No. 462H is ¼-in. capacity and has pistol-type handle. Stanley Electric Tool Division, The Stanley Works ,New Britain, Conn.

Lubricating Oil

"Superfilm Lathe Center Point Oil" is a pure mineral oil. It is designed for use on excessive friction operations and has high film strength. A drop or two is all that is required for normal operations. Prevents overheating and annealing of center points. Speeds up work and allows much heavier cuts in machine operations. Manufacturer recommends it for use on lathe centers, lathe steady and center rests, milling machines, universal grinders, planer beds, cold swagging, rivet spinning machines, heavy journals and rolls, etc. Chicago Manufacturing & Distributing Co., 1934 West 46th St., Chicago.

Insulation Tester



Insulation resistance test set has a guarded circuit and is said to be free from effects of leakage currents. Switches are designed to simplify operation and eliminate calculations. Calibration of the galvanometer deflections is facilitated by a special shunt, the turning of which to the calibrating portion automatically connects the circuit for calibration. Results are obtained by dividing the calibration reading by the test reading. Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia.

Welding Hose

"Tu-Line" welding hose is of single-unit construction with two separate lanes for the gases to pass through. Has thick, tough cover, yet is quite flexible. With-

CUT YOUR COSTS WITH *TESTED* HOSE!

HERE you see some of the reasons why Goodyear industrial hose gives longer, more economical wear. As the world's largest rubber company, Goodyear maintains the largest and most complete research and development laboratories in the industry. We solve your hose problems for you — *in advance* — by constant testing under conditions even more rigorous than met in actual service. Further to insure lowest ultimate-cost performance all Goodyear hose is individually specified to your operation by the G. T. M. — Goodyear Technical Man—a practical authority on all industrial hose applications. To consult the G. T. M. write Goodyear, Akron, O., or Los Angeles, Calif. — or the nearest Goodyear Mechanical Rubber Goods Distributor.

THE GUILLOTINE—hose must stand severe impacts from this heavy trip-hammer, without cover or carcass failure, to meet Goodyear's specifications.

FLEX TEST — under 200 pounds saturated steam pressure, hose is flexed on this "rack" to prove that Goodyear steam hose gives the long service life typical of all Goodyear products.

115 TIMES A MINUTE this motor-driven "hose beater" hammers Goodyear hose against a concrete slab to test the abrasion resistance of Goodyear cover stocks.

OIL TEST—Goodyear air hose is subjected to tests which determine the resistance of the rubber stocks against the deteriorating effect of oil.

STRETCH TEST — all rubber compounds used in Goodyear hose are checked with this device—another test to make certain that only the best materials are used in these products.

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HOSE
PACKING
Made by the makers of Goodyear Tires

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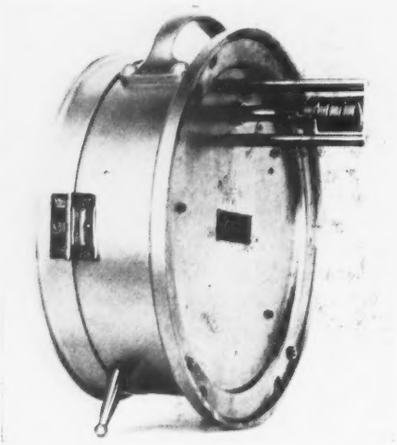
GOODYEAR
BATTERY

stands abrasion, sharp corners, and broken edges. Lanes are decagonal in shape and cannot roll underfoot. Construction is extra-heavy single braid with special compounded tube of smooth, non-blooming stock. Made in ¼-in. size only, but is furnished in convenient lengths up to 300 ft. Separated between the two conduits the proper distance to allow attachment to standard equipment. Quaker City Rubber Co., Frankford P. O., Philadelphia.

Temperature Recorder

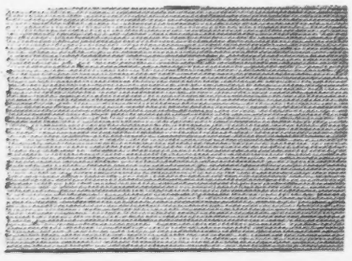
Portable recording thermometer is designed for use in traveling baking, finishing, and enameling ovens. Passes through



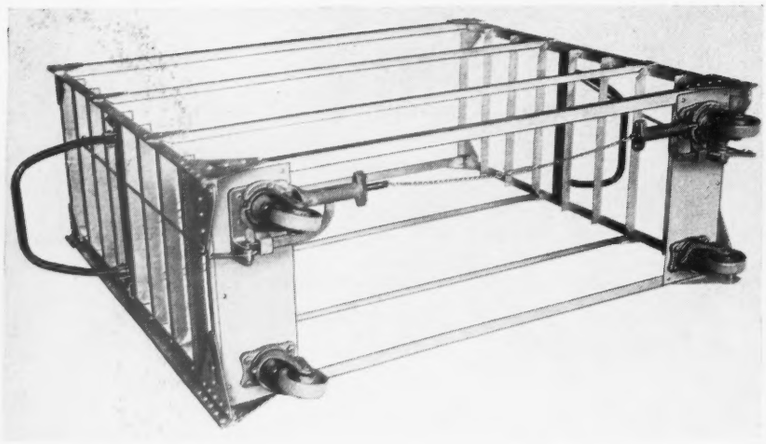
oven on the conveyor with the work and gives a continuous record of the temperatures to which the heated product is subjected. Is valuable in maintaining proper temperature for the product being processed. Light in weight, it is compact and self-contained. Record is made on an 8-in. round chart for 24-hr. or 7-day clock rotation. The Bristol Co., Waterbury, Conn.

Conveyor Belting

Conveyor belting is constructed of plies of weftless cords such as are used in truck tires. This gives a carcass in which every tension member is completely surrounded and insulated with rubber to increase its ability to absorb and withstand shock. Since these cords have no transverse or filler threads obstructing their



freedom of movement, they are free to distort themselves. The belting is said to have extreme transverse and longitudinal flexibility. It is also said to have great resistance to moisture and acid penetration because of the fact that the carcass is impregnated with rubber. Each individual cord is surrounded by a layer of rubber which protects it against penetration of moisture and corrosion. Available in any length, width, and number of plies. Must be spliced by vulcanizing. The B. F. Goodrich Co., Akron, Ohio.



Truck Caster Control

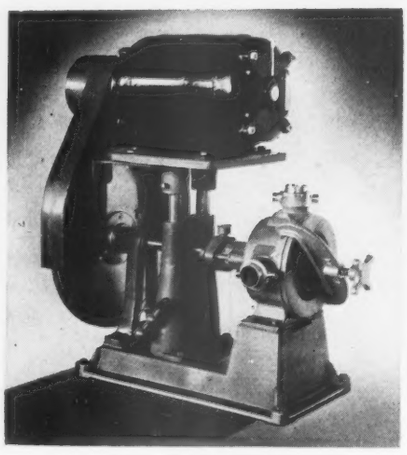
Industrial trucks equipped with this caster control mechanism can be guided by it rather than by force. One man can push or pull the truck in a straight line, around corners or obstructions, or in any direction. His hands and feet may at all times be 12 in. or more away from the truck, avoiding skinning or crushing knuckles. When the control mechanism is applied, the locking of a single caster causes horizontal mate to move in line, while the other casters are left free to swivel. The truck can then be moved in a straight line. When the handle is lowered the lock is released and the truck is then in neutral, that is, all four casters are free to swivel. Bond Foundry & Machine Co., Manheim, Lancaster Co., Pa.

Porcelain Pipe

Acid-resisting pipe is made of pure porcelain and is glazed inside and out. The porcelain is said to be non-porous and non-absorbent, so that a scratch or crack will not permit liquid to be absorbed or contaminated. The pipe is glossy white and is supplied with chromium-plated fittings. Lapp Insulator Co., Le Roy, N. Y.

Pump

Variable-speed, variable-capacity rotary pump unit is built in both standard and sanitary models, the latter for use in food plants. Mounted on a flat base. Turning a small handwheel located near the base plate raises or lowers the motor base plate, increasing or decreasing pitch of the V-belt motor pulley by means of contracting



or expanding the side walls of the pulley. This in turn changes motor speed and pump capacity. Unit uses standard 1,800-r.p.m. motor and speed ranges of 200 to 500 r.p.m. are possible. Speed and capacity can be changed at any time, while the unit is in operation. Pumps of two sizes are available, using single-belt vari-speed unit, which in turn uses 1-hp. motor. Two other sizes are also available where a 2-hp. motor is used and a two-rope vari-speed unit. Units are equipped with casters. Viking Pump Co., Cedar Falls, Iowa.

Welder

Model 250 a.c. arc welder has plug-in type control panel. Has output range from 25 to 250 amp. in 10 steps. Flexible, rubber-covered welding cable is 15 ft. long; the weather-proof, braided ground cable is the same length. Cast steel case and cast steel, ball bearing, swivel casters. Operates

on 220- or 440-volt, 50- or 60-cycle current. Forced-draft cooling system and inclosed power terminals. Takes rods up to ¼ in. The Commonwealth Mfg. Corp., 4208 Davis Lane, Cincinnati.

Controllers

The "Masoneilan" air-operated potentiometer controller is a combination of the company's air-operated control and a potentiometer system of temperature measurements. It is designed for applications such as still outlets and gas- or oil-fired electric furnaces and ovens. It measures, indicates, records, and controls; requires approximately 20 lb. air supply. Uses 10-in. strip chart approximately 120 ft. in length. The

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Now, there is further assurance of Better Light and Lower Maintenance Costs through the specification of RLM labeled reflectors.

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Basically the RLM LABEL stands for:

1 MORE LIGHT AT NO EXTRA COST

Efficiency specifications are 10-12% higher than average reflector efficiency.

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Proper distribution and adequate diffusion are just as important as the amount of light. RLM Specification Porcelain Enamel has no known equal as a reflecting surface for Balanced Lighting.

3 LOW REPLACEMENT & MAINTENANCE COST

RLM Specification high quality porcelain enamel is the most durable of all reflecting surfaces. Being easier to clean, maintenance costs are reduced to a minimum.

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To insure uniformity of quality and conformance to RLM Specifications, inspections and tests are continuously conducted by the Electrical Testing Laboratories of New York, an independent Testing Organization.

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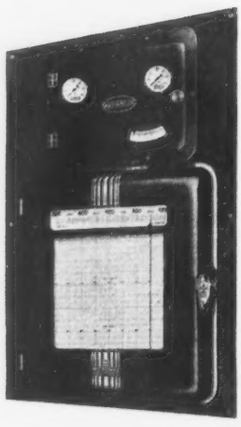


air-operated control unit is available in one of three forms, all interchangeable. These are designated as single, dual, and drift compensators. Instrument is available for use on 110-volt a.c., 25, 50, or 60 cycles, or for 110- or 220-volt, d.c. Range between zero and 2,000 deg. F. Range is designated for iron-constantan thermocouples, but other thermocouples and other ranges up to 3,000 deg. F. are available to specification. The air-relay system is independent of the electric system and there is no air bleed in the potentiometer case. An automatic locking device permits cutting out the control system or removing it entirely, without interfering with the potentiometer operation. Overall dimensions are approximately 32 in. high, 18¼ in. wide, 12⅝ in. deep. Mason Neilan Regulator Co., 1190 Adams St., Boston.

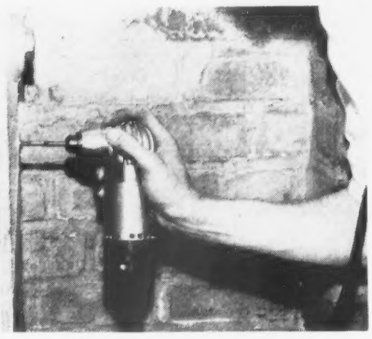
Caster Swivel Fork

Swivel fork for a low-pressure Doenut tired caster is made of heavy-gage pressed steel, and is furnished with a flat plate or stud so that it may be adapted to any type of unit. The flat plate model is 11¾ in.

high. Load capacity of the caster unit of either type is 225 lb. per wheel. Wheel is standard 4½-in. diameter, of cadmium-plated steel and double-disk-type construction. Tire is 10 in. high and 2¾ in. in diameter. Musselman Products Co., 6278 St. Clair Ave., Cleveland.

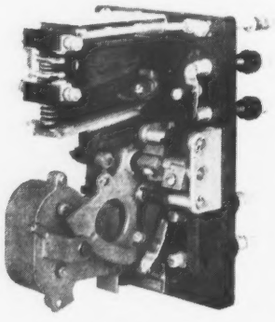
Drill

"Shorty" electric drill has chuck spindle mounted at right angle to the motor, reducing overall working length of the tool to 4½ in. Motor housing has also been reduced to a minimum so that tool fits snugly in operator's hands and requires no extra handle. Deep vents cast in the gearhead provide for free passage of air even though the tool is grasped by the head. Tapered end of gearhead extends over the chuck, protecting operator's fingers. Ball-bearing equipped throughout, and has universal motor. Removable insulation cap provides easy access to brushes for inspection. Thumb control switch is in the line just back of tool. Available in either ⅜- or ¼-in. capacities. Smaller size has no-load speed of 3,700 r.p.m.; full load, 2,300 r.p.m. Also optional speeds: no load, 5,000; and full load, 3,200 r.p.m. One-quarter-inch size: no-load speed, 2,500 r.p.m.; full load, 1,600 r.p.m. Standard voltage is 110, but also available for 220 or 250 volts. Black & Decker Mfg. Co., Towson, Md.



Relays

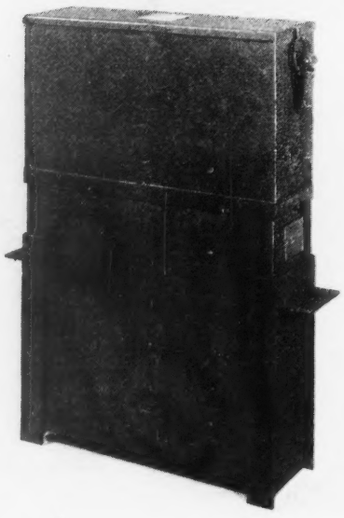
CR2820-1729 relay is a definite-time relay for timing a sequence of operations in a control system. It employs a clutch-type, time-delay interlock. Available in either a.c. or d.c. forms with 2, 4, or 6 circuits. Consists of a solenoid and



plunger which is mechanically connected to the time-delay mechanism and to a shaft that operates the contact fingers. On the d.c. forms a separate, small instantaneous cutout switch is mounted on front of the solenoid. Positive and uniform operation is assured by coil springs which give a constant pull on the timing mechanism throughout the operating cycle. General Electric Co., Schenectady, N. Y.

Capacitors

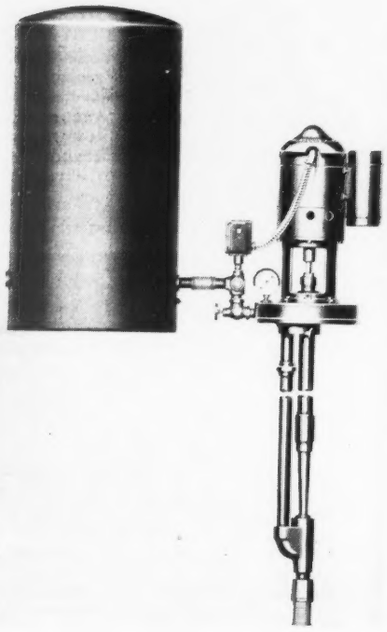
Dust-tight capacitors for use in plants with dust-laden atmospheres. Consist of three parts: Capacitor unit proper, dust-tight terminal compartment, and mounting supports. Capacitor unit is of Inerteen type in a heavy welded sheet steel case with rugged porcelain terminals mounted into case. Dust-tight terminal inclosure is designed to mount on the capacitor unit sealing on a gasket of felt. A felt gasket is also used under the cover which is held down by spring latches. The terminal inclosure contains boric acid fuses and discharge resistors. Two types of mounting supports are available: One for mounting in an angle iron rack structure, the other



for mounting on the floor. Several of these capacitors may be placed side by side about 1 in. apart and connected together by means of 1½-in. flexible or rigid conduit. Available in 5- and 7½-kva., 230-volt, 60-cycle rating, and 5-, 10-, and 15-kva., 460- and 575-volt ratings. Westinghouse Electric & Mfg. Co., East Pittsburgh.

Well Pump

Vertical, close-coupled, motor-driven centrifugal pump for general service in deep or shallow wells pumps water at a high or low pressure at 6 to 60 gal. per min. Because of compact construction, only a small space is needed for installation. It requires little attention and no lubrication is necessary. No mechanical moving parts below ground. Units for shallow well service consist of combined motor, pump, and base, into bottom of which is screwed a single suction pipe extending below the water level. This is satisfactory for water lifts of 15 to 20 ft. Pumps for deep wells —20 to 200 ft. deep—are equipped with an ejector and Venturi in one of two drop pipes extending from the pump down into the well. Fairbanks, Morse & Co., 900 South Wabash Ave., Chicago.



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Your product, shipped in a Gaylord Box, is protected by the famous Gaylord "Extra Margin of Safety"... the reserve strength built into every Gaylord Box that assures safe, unmarred arrival of its contents.

In American industry, the Gaylord name on corrugated or solid fibre shipping containers is recognized as the seal of shipping safety.

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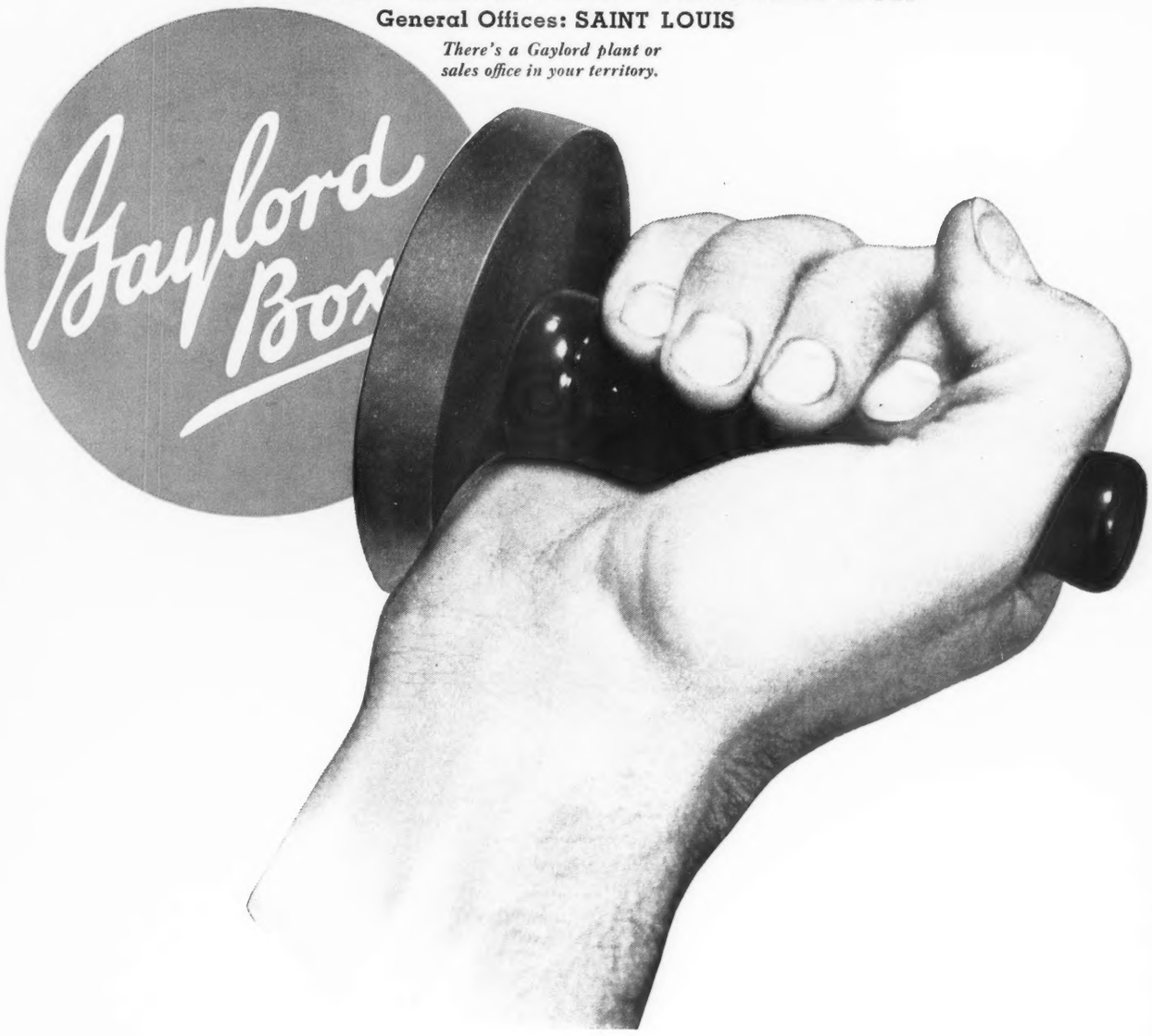
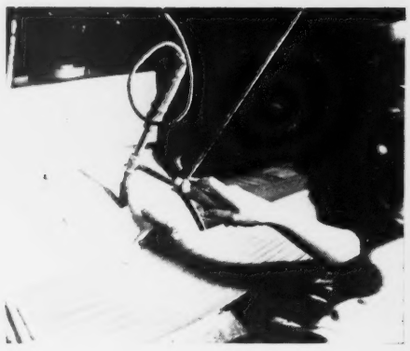


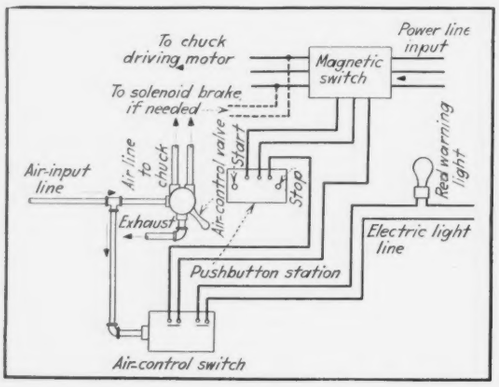
Operating Shorts



Operating Air Chucks with Safety

PAUL L. KUZMICK, *The Manhattan Rubber Mfg. Division of Raybestos-Manhattan, Inc., Passaic, N. J.*

We have replaced several manually operated, geared screw chucks with the air-operated, controlled type. On lathes and grinders this type of installation naturally speeds up production but is a hazard when operated without any protection against the sudden exhaustion of air from operating lines. This is especially true when the chuck rotates at high speeds.



In our work we finish and bore pieces weighing from approximately 1 lb. to better than 200 lb., with speeds up to 300 r.p.m. Should air pressure be cut off suddenly, these pieces would be whirled loose and thrown toward the operator who must, of necessity, stand directly in front or slightly to the right of the work.

To safeguard against such accidents, we installed an air-control switch ahead of the air-control valve serving the air cylinder controlling the chuck. Also, a red warning lamp was placed directly in front of the operator at eye level.

Our operating pressure range is 30 to 90 lb., and so long as we maintain this pressure, the red warning light glows, indicating proper working condition. But should air pressure drop to 15 lb., the circuit is broken, putting the lamp out and warning the operator. Simultaneously, the chuck driving motor is cut out dead, preventing the work from being whirled loose, out of the chuck, and toward the operator. He is protected from serious or fatal injury. Cutting out at 15 lb. pressure allows the chuck to come to a complete stop before all air is exhausted from the lines.

When pressure is restored, the warning light flashes on at 13 lb. gage pressure, indicating to the operator that there is sufficient pressure to commence work again. The pushbutton motor starter must be pushed manually to start rotation of work once more, thus eliminating sudden automatic restart which would be another hazard.

On the high-speed turret lathes, it may be necessary to decelerate the work chuck by installing a spring brake and solenoid. The solenoid can be installed as shown in the sketch, being energized so long as there is sufficient pressure. This holds the brake open, but as soon as air pressure drops to 15 lb. the solenoid will be de-energized, allowing the spring brake to decelerate the work chuck.

Since a complete installation of this type costs approximately $25, it is within the reach of everyone using air-actuated chucks. In our department we consider this one of our most important safety installations.

Mr. Kuzmick's contribution has been awarded the $15 payment offered by the editors for the best Operating Short submitted during the past month.

•

By simple drawings showing position of operators with respect to machinery before, during, and after an accident, Columbia Steel Company, Pittsburgh, got its men to read safety reports, become safety conscious.

Pre-Positioned Tool Eliminates Two Motions

SOURCE, *The American Hard Rubber Company, Butler, N. J.*

By applying motion study principles to a simple thermoplastic patching operation, this concern has cut five motions to three. An electric soldering iron is used. Pre-positioned for quick grasp, it rests in the well containing the patching material when it is not in use. Thus the heated tip of the iron keeps the thermoplastic liquid. Under the old method, the plastic cooled when the iron was laid aside.

A drop of the patching material adheres to the iron when it is lifted. Thus two motions—to and from the well—have been eliminated by the pre-positioning.

•

Safety Through an Exhaust System

SOURCE, *S. C. Johnson & Son, Inc. Racine, Wis.*

Decreasing the fire risk is the purpose successfully accomplished by special exhaust systems used in our varnish mixing operation and in the

Special Notice

$15 will be paid for the best Operating Short submitted during the month of December. The Editors are the judges. Other Shorts accepted will be paid for at attractive rates

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in the I-T-E KLAMP-TITE SWITCH

CONTACTS rigidly held under thousands of pounds constant pressure . . . Easy to operate, as though making a bolted bus joint with one throw of a handle . . . SAFE! There are *reasons* why KLAMP-TITE is replacing the conventional knife switch.

Hook-stick operated Klamp-Tites, mounted up out of the way, are supplanting old-style, troublesome safety switches.

Single and multi-pole standard types available in capacity from 400 amperes upward in a wide voltage range. Ease of installation and other features are described in I-T-E Bulletin 1136, which will be promptly sent on request.

I-T-E

Representatives in Principal Cities

I-T-E CIRCUIT BREAKER CO., PHILADELPHIA, PA.

condensation and recovery of volatile solvent fumes. While the method was specifically designed for heating varnish, the basic idea should be usable in lines materially different.

Large kettles mounted on four-wheel trucks are loaded with varnish gums and vegetable oils, and trucked to the gas-burning varnish fires. There they are placed above the gas burners, and, before the fires are lighted, are covered with almost-air-tight covers which have a flexible hose outlet attached to the center and connected with overhead exhaust pipes. Then the gas is lighted, and the oils and gums cooked to a temperature between 550 and 600 deg.

After the cooking, the kettle is moved to another location for cooling, and another flexible hose is connected to the cover to exhaust the fumes while the mixture cools off.

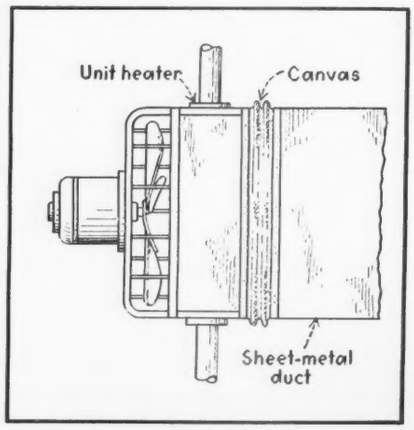
When the temperature is down to about 450 deg., the hose is disconnected; the kettle is trucked to a separate room where the varnish is thinned with naptha, turpentine, or other volatile solvent. Before thinning with the volatile thinner, a flexible hose is again connected, this time to an exhaust condensation system. The volatile fumes arising from this hot base are condensed and collected in a closed container in the basement of the building.

Poor maintenance depreciates a machine just as do use and time.

Duct Vibration Eliminated by Canvas Insulation

H. C. SLEMAN, *New York*

Recently it became desirable to divide a storeroom into two sections separated by a partition. The problem of heating both sections was solved by installing a system of ducts



and dampers attached to the outlet of the unit heater that previously had served the whole area. This expedient eliminated the necessity of putting in another heater, but there was much complaint from the storeroom personnel about noise in the ducts.

Investigation revealed that the noise was the result of vibration transmitted from the heater shell to the light sheet iron of the ducts. Apparently the simplest way of overcoming the trouble was to insulate the ducts from the heater by a short section of heavy canvas, as shown.

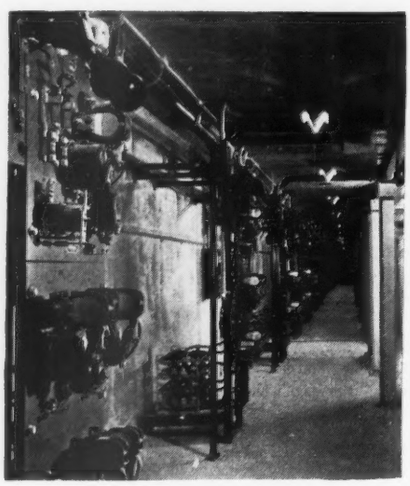
Lighting Electrical Equipment in a Tunnel

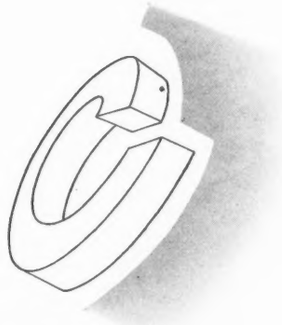
SOURCE, *Republic Steel Corporation South Chicago, Ill.*

An ingenious application of equipment designed for a highly specialized task to a problem in a totally different field, through seeing the similarity of the two, is to be found in a lighting installation below ground at this wire mill.

As shown in the picture, all manner of electrical transmission and auxiliary equipment is set in tunnels underneath this plant. No high-intensity worklight is required here, but it is desired that the light be sufficient to permit quick and thorough inspection by a maintenance man passing through, and ample light for his work if he has to do any. The problem is removed from simplicity to something rather difficult because much of the equipment is close against the ceiling, which ruled out ordinary porcelain-finished metal reflectors. The type of location, and the fact that work would have to be done and heavy tools and equipment moved around occasionally at high levels, made it improbable that translucent types of diffusers would have long or satisfactory life.

The electrical engineer in charge of the construction remembered a type of fixture he had seen in entirely different surroundings. This was a metal reflector especially designed for use in lighting the aisles between book stacks in large libraries. The light is thrown out on two sides, is blocked off and reflected crosswise by two wings extending the long way of the reflector. Designed to throw light on books on both sides of a narrow aisle, all the way to the top level of the fixture and down to the floor, it seemed to fit the tunnel job perfectly. How well it fits may be seen





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by examining the picture made from a photograph taken by a time exposure in the light from these fixtures.

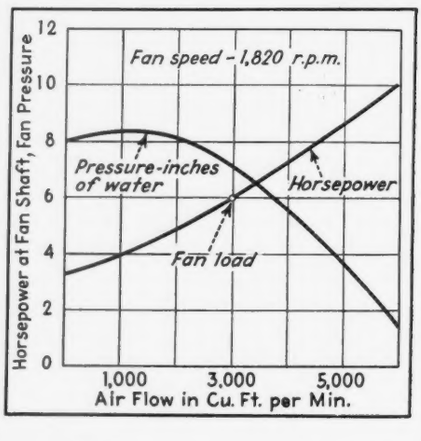
Several foundries have increased production by heating their patterns electrically. The warm pattern dries the sand around it, giving a perfect mold.

Measuring Air Moved by a Centrifugal Fan

H. M. NICHOLS, *Manager, Conveying Department, B. F. Sturtevant Company Hyde Park, Mass.*

Plant engineers are frequently confronted with the problem of measuring the volume of air moved by a centrifugal fan in connection with a piping system for conveying material in an air stream, exhausting dust and fumes, or supplying air for combustion.

As a rule the fans are of the housed, centrifugal type with radial or forward-curved blades, and driven by individual electric motors. Where this is the case a very close determination of the fan performance can be obtained by measuring the fan speed and the watts input to the motor. The horsepower input to the



fan shaft is then computed by multiplying the electrical horsepower input by the motor efficiency, making allowance for the power loss in the drive, unless the fan is direct connected to the motor.

The next step is to plot pressure and horsepower curves for the fan at the operating speed. The data for these curves is taken from the manufacturer's catalog. If it so happens that there are no catalog ratings for the exact speed required, they can be obtained by taking the

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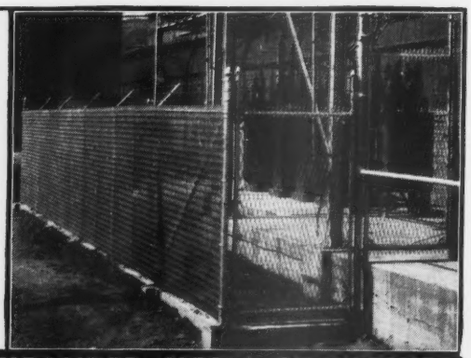

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catalog ratings of volume, pressure, and horsepower for any given speed and correcting the volume by the ratio of the speeds, the fan pressure by the square of this ratio, and the fan horsepower by the cube of this ratio.

Housed, centrifugal fans of the radial or forward-curved-blade type have a steeply rising horsepower curve as can be seen from the accompanying illustration, and due to that condition there is only one combination of volume and pressure that will correspond to a given horsepower reading at a given speed.

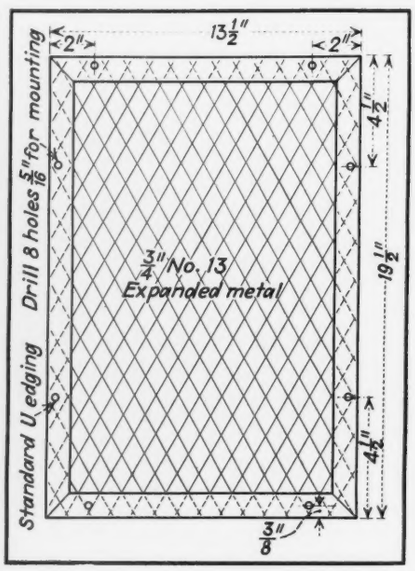
Therefore, after having plotted the fan curves for the given speeds, all that is necessary it to spot the horsepower input to the fan on the horsepower curve and from that position read the corresponding volume of air and pressure developed by the fan. For example, with a 6-hp. fan load at 1,820 r.p.m. the fan is handling 3,000 cu.ft. per min. at 7.1 in. pressure.

An ordinary wire paper clip slipped over the tabs of a card index will help to prevent them from breaking off under the frequent bending to which they are subjected.

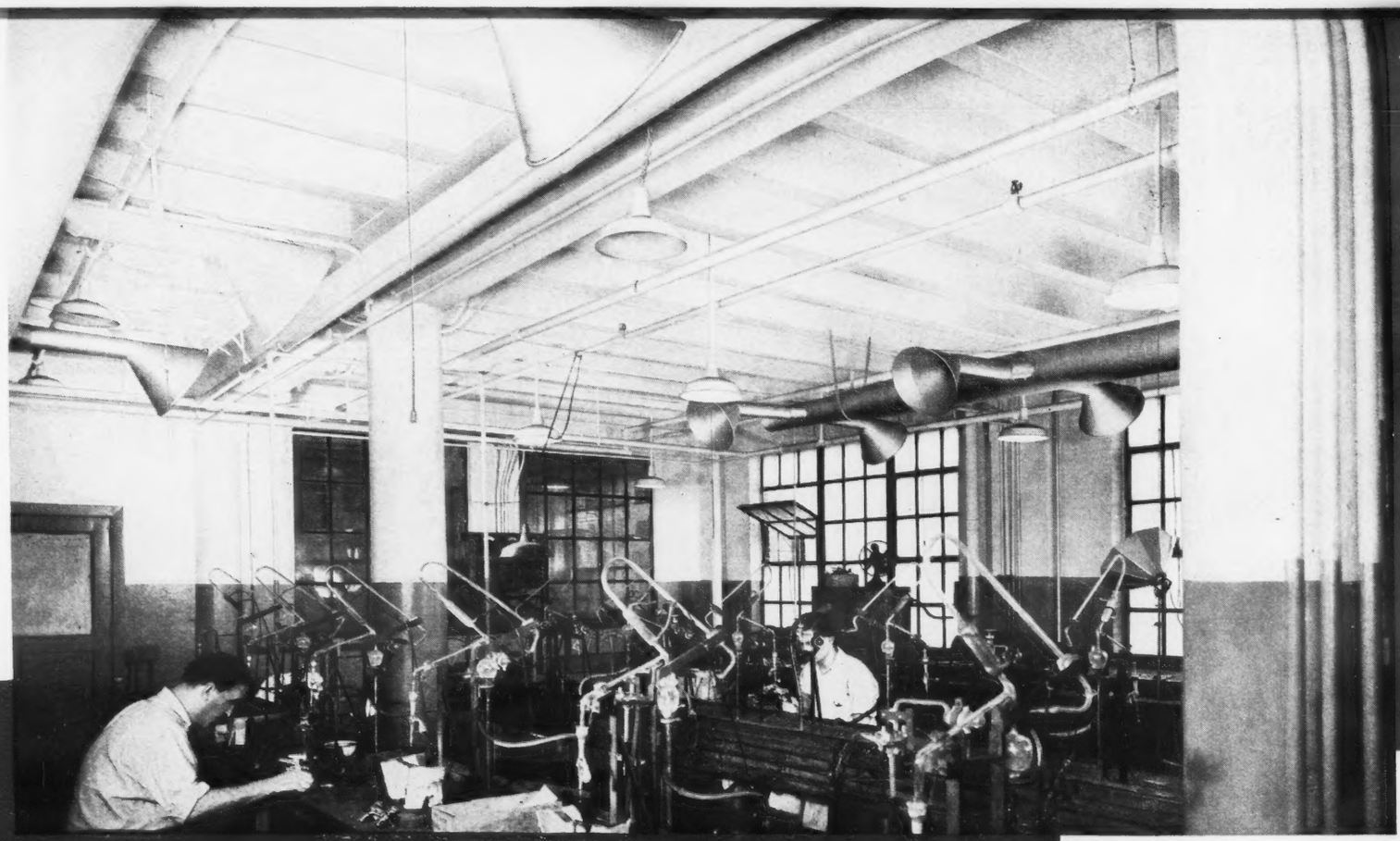
Simple Guard Will Protect Glass in Doors

C. C. HERMANN, *Philadelphia*

Glass in factory doors is practically a necessity because it helps to prevent collisions and accidents, but how to protect it is a problem. Unless some measures are taken to pre-



THERE'S NO SUCH THING AS AN "ALL-PURPOSE" MILL WHITE!



No single white interior paint can withstand all the varied conditions prevailing in every modern plant. For ordinary interior painting use, you need a "general" paint. In Save-Lite regular the basic Sherwin-Williams Save-Lite, you will find the greatest light reflection, cleanliness, durability and economy possible to produce in a white paint for all ordinary plant interior painting.

For those sections of your plant subject to varied degrees of heat and fumes, Sherwin-Williams has specially formulated several types of fume-resisting Save-Lite. Each has been made to do a special job—more *economically*.

The Sherwin-Williams Painting Engineer will gladly specify the correct type of Save-Lite to use in any part of your plant. Let him make a survey. No cost or obligation.

FREE—this complete report on "Plant Conditioning." Every plant operator should have it. Write The Sherwin-Williams Co., Cleveland, Ohio, and all principal cities.

In the Burner Filling room at Hanovia Chemical & Mfg. Co., Inc., Newark, N. J., (makers of Alpine Sun Lamps) paint must fight fumes, as well as efficiently reflect light. That's why Hanovia chose Save-Lite.

See the Sherwin-Williams Painting Engineer.

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These compact, all purpose, efficient pumps are available in standard construction for handling ordinary liquids and in special materials for corrosive and other "hard to handle" liquids.

Installation is simple for they will operate in any position; operating costs low, for these pumps are highly efficient. Maintenance expense is negligible, for substantial design and careful workmanship together with the finest of materials insure long life and freedom from shutdowns for repairs.

No matter how exacting your requirements may be, there is a GOULDS "Close-Cupld" Centrifugal Pump ready to do your pump job efficiently. Twenty-one sizes with a capacity range of 5 to 1600 G.P.M. for heads up to 525 ft. Standard and special constructions and many types of motors. Here is a line of pumps on which you will want to have complete data.

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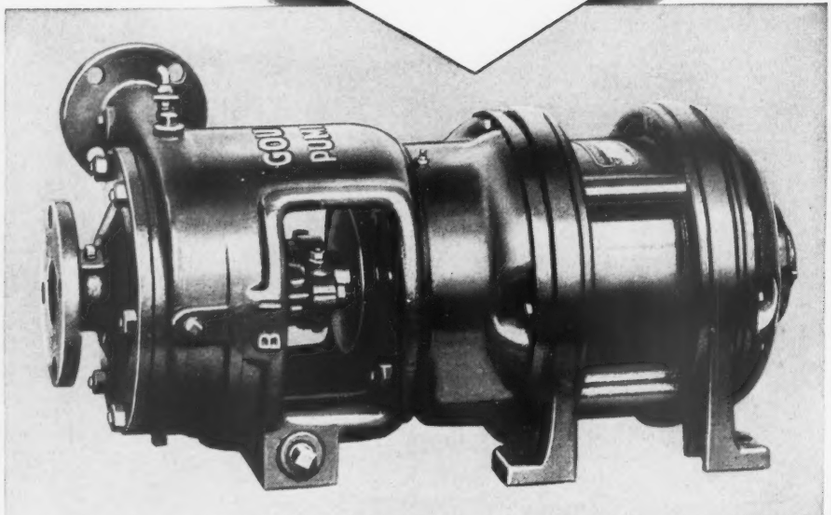

Goulds Figure No. 3620 Close-Cupld Centrifugal Pump for general service pumping. Compact, low-cost, highly efficient. Complete unit can be operated in any position.

7337

vent breakage a serious hazard is introduced. At the same time, unnecessary obstruction of vision must be avoided.

Many different types of guards were tried before adoption of the one shown in the illustration. This guard is made of $\frac{3}{4}$-in. diamond mesh of No. 13 gage. Expanded metal such as is used for reinforcing may be employed provided all burrs and sharp edges are removed. This may be done by putting the material in a dilute solution of sulphuric acid for a short time, or it may be sand-blasted until the edges are worn off.

Electrically welded round-wire mesh may also be used. I have found, however, that the expanded metal is somewhat stiffer and thus affords greater protection.

The glass must be protected on both sides; so two guards must be made for each door. They are made $1\frac{1}{2}$ in. larger all around than the window opening. The steel frame is made of $\frac{3}{4}$-in., No. 12 gage, round-edge steel with mitered ends. Holes for the through-bolts should be punched in a die, or laid out accurately and drilled so that all holes will match exactly.

After fabrication the guard is painted black, using a good grade of enamel, and mounted over the glass. Painting the guard black will improve vision through the glass, whereas white or other light color will tend to hinder it.

In mounting the guard on the door use through-rivets which will pass through the guard frame on both sides. If the rivets are beaded over after splitting the end with a cold chisel, rather than peened to a regular rivet head, the guard will be easier to remove when repairs are necessary. After splitting the ends of the rivets the halves are merely turned sufficiently to hold the guard tightly in place.

Bolts should not be used because the heads and burrs are likely to catch on loads passing through the door, causing damage to the guard and possibly to the material being moved.

•

Finding the Proper Gage Quickly

JOHN E. HYLER, *Peoria, Ill.*

One cause of lost time in many inspection operations is the finding of the proper gage notch or opening. This is especially true where a large number of pieces is being inspected. Whether it is a wire gage, a rolling mill gage, drill gage or any

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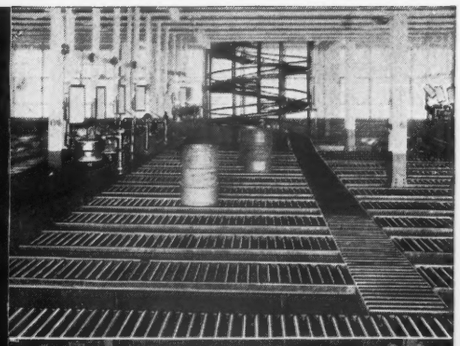

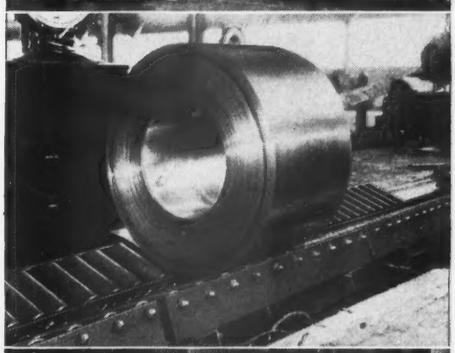

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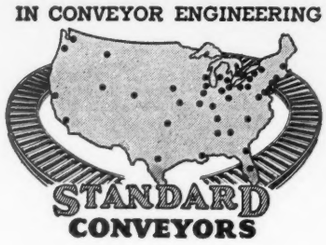

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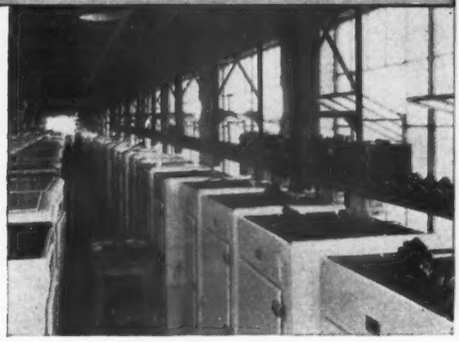

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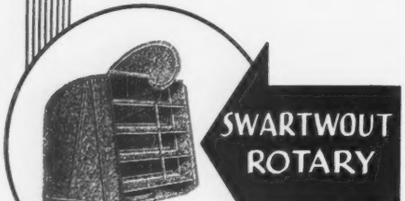
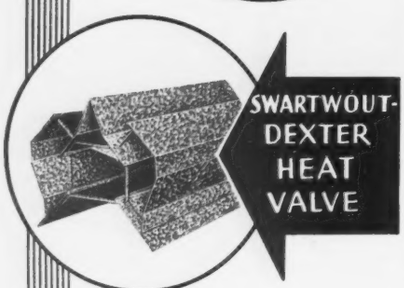




other type being used, time is consumed looking for the right notch.

A simple means of overcoming such trouble is simply to cover up those holes not in use, or at least those immediately adjacent to the one in use. On a circular wire gage a device can be attached that will leave only the one notch in use at the time exposed.

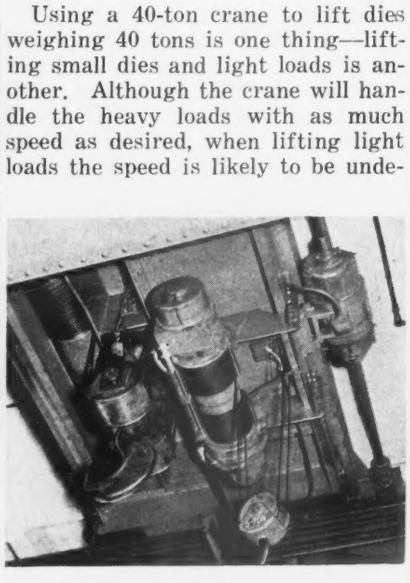
In most cases, it is really not necessary to cover up all gage notches but one, but only those immediately adjacent. Take a rolling mill gage for instance; say the operator is working 20 gage. Two small metal clips slipped over the edge of the gage, covering notches 19 and 21, will make notch 20 stand out.

Replacing steam coils with electric strip heaters as source of heat for shoe-drying racks made it possible for a shoe manufacturer to shut down one boiler during the summer months.

Hoist Adapts Large Crane for Handling Light Loads

SOURCE, *Harnischfeger Corporation Milwaukee*

Using a 40-ton crane to lift dies weighing 40 tons is one thing—lifting small dies and light loads is another. Although the crane will handle the heavy loads with as much speed as desired, when lifting light loads the speed is likely to be unde-

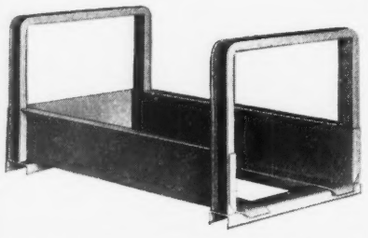


sirably low. Furthermore, there is a waste of electrical energy when a crane of this size is operated at a small fraction of its capacity.

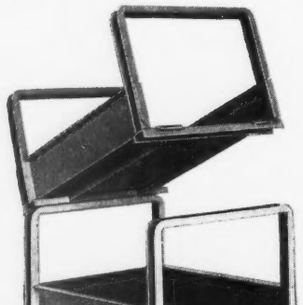
In the press room of the Seaman Body Corporation, Milwaukee, a 40-ton crane is often called upon to handle dies weighing from 30 to 40 tons, but 80 per cent of the lifts involve weights of less than 5 tons. In order to speed up the handling of light

STOCKROOMS
Can Earn Profits, Too!

Your stockroom can actually show profits over its present costs if you equip it with STACKRACKS — a big profit from the saving in floor space when boxes are piled compactly in these inexpensive sturdy steel racks—another from the saving in time and labor as your boxes slide conveniently in or out, independent of each other.



STACKRACKS are individual racks made to fit your stock boxes; built of channel and formed steel welded to form a rigid unit.



Any man, without tools, can quickly fit them together into self-locking units of any height, any shape—in corners or around posts, under benches or to the ceiling. And they can be moved just as easily any time, to any place desired.

The complete stack is rigid. High STACKRACK storage is safe. Valuable floor space is freed of box piles. Costly time and labor are saved because boxes slide in or out like drawers. Write for descriptive literature on STACKRACKS.

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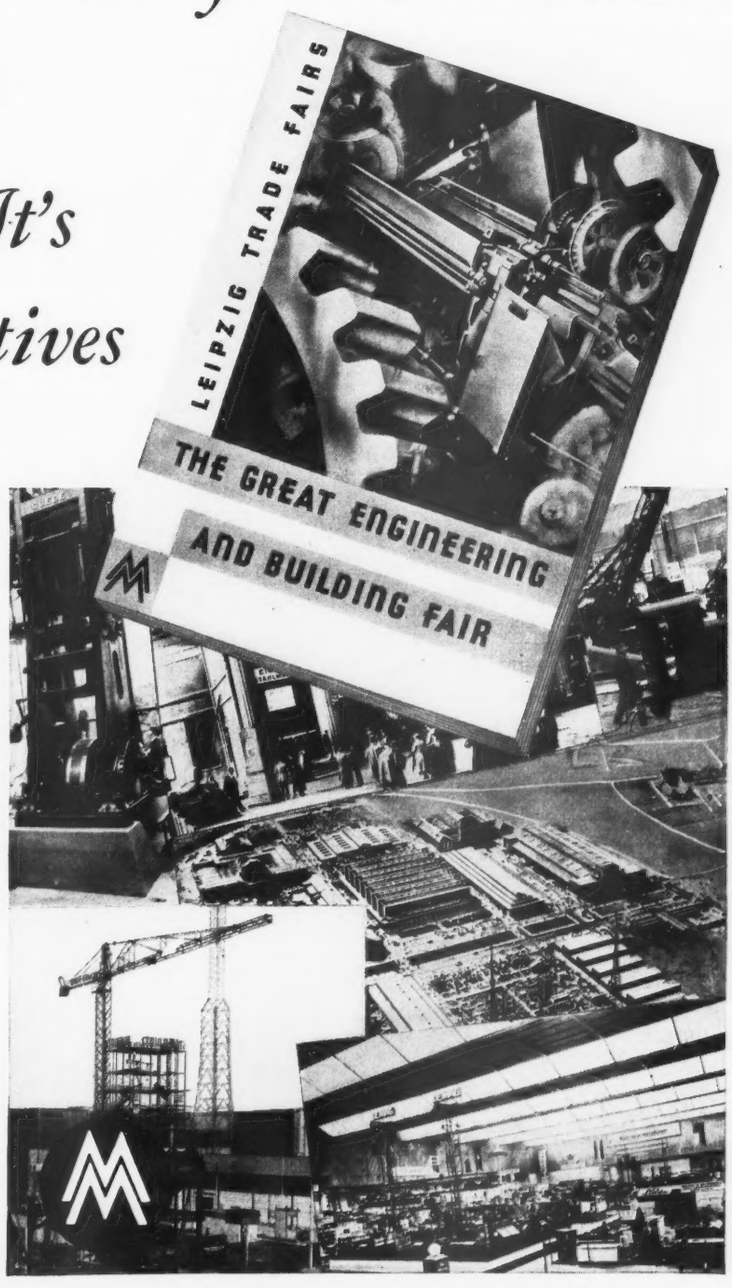

If efficient equipment, labor-saving machinery, new short-cut methods or other technical improvements play any part in determining the profits of your business, the Leipzig Trade Fairs have something real to offer you.

The Great Engineering and Building Fair, held in Leipzig each Spring, features more than 2,500 exhibitors. The exhibits cover the latest in equipment, machinery, tools and processes for practically every industry. For your convenience all are classified and grouped in 17 gigantic halls as well as many acres of open-air space. Some 5,000 machines are in actual operation.

To appreciate the importance of this gigantic Fair, consider for a moment such figures as 444 exhibitors of machine tools; 217 exhibits of highly specialized production machinery for the working of wood, glass, plastics and other materials; 395 exhibitors featuring building, construction and sanitary equipment; 416 exhibits of electrical equipment; 246 exhibits of machines for the textile, paper and graphic arts industries.

Simultaneously in Leipzig are held the General Merchandise Fairs, where the latest in both finished and semi-finished goods are exhibited. In the combined Fairs there are more than 8,500 exhibits from 25 countries; they are inspected by 250,000 business executives and buyers from 72 countries.

To give you a more complete picture of the Great Engineering and Building Fair, we would like to send you a copy of our new book, pictured above. It describes and pictures the Fair in considerable detail. There is no charge or obligation. Write on your letterhead and ask for book No. 61. Leipzig Trade Fair, Inc., 10 East 40th Street, New York.

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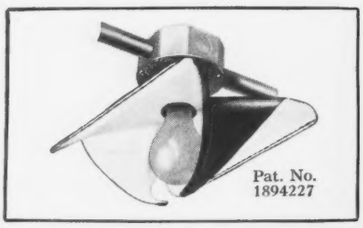
"Do your stock clerks spend their lives in the murky gloom? . . . fishing into dark bins? . . . squinting to identify parts numbers? . . . moving from dark to light to read their orders? Now, it costs but a trifle to correct this bad situation with this revolutionary new reflector, designed specifically for use in narrow aisles."

THE STOCKLITE

A Radical Improvement in Stock Bin Illumination

Makes it possible to read labels, numbers, typewritten slips, etc., anywhere in stock bin aisles. Delivers a high intensity of light, properly diffused, from top to bottom shelf and on shelf surfaces. Eliminates glare—speeds handling.



THIS ODD SHAPE DOES IT!
Note how this reflector directs light to the sides—how the curved V-shaped flange eliminates aisle glare—how it uses the lamp's full efficiency. Vitrified enamel finish insures lifetime service. An exclusive Goodrich product.

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GENERAL OFFICES AND FACTORY: 2904 N. OAKLEY AVENUE, CHICAGO, ILL.

loads it was suggested that an extra trolley be installed on the crane, to serve as an auxiliary hook. This arrangement, however, would have kept the main hook trolley from getting enough end approach—and heavy lifts are frequently made along the wall.

At length a 5-ton hoist was installed under the trolley, next to the hook. This hoist, which is controlled from the crane cab in the same manner as though it were an auxiliary hook, has a maximum lift of 30 ft., and a hoisting speed of 35 f.p.m. At 1,140 r.p.m. its motor is rated 15 horsepower.

On pressure spray barrels operating under low pressure, have the supply line a low-pressure one so that barrels aren't overloaded if safety valves fail.

Striped Rotating Parts Show Machines in Motion

A. W. EIDMAN, *Cleveland Heights, Ohio*

When motors and equipment are situated at a considerable distance from the operator's control station, it is often difficult to determine whether or not the parts are in motion. From a safety standpoint, this is of particular importance in trouble-shooting and experimental work, when rapidly moving parts cannot be adequately guarded.

If such a rotating or oscillating part is painted in a contrasting color and a simple pattern, such as diagonal stripes, this pattern can be distinguished only when the part is motionless. The pattern changes to a flat gray color when the machine is running.

"Stop" buttons should be located at frequent intervals along conveyors to stop them when danger to an employee arises.

Raised Cable Manholes Prevent Flooding

S. H. COLEMAN, *Roanoke, Va.*

Unless the walls of cable manholes are built sufficiently high above the ground surface, storm water often causes trouble. When large quantities of this water carrying mud and trash enter the man-

CONTENTS: ALUMINUM P… TESTING OF ALUMINUM

P… VEHICLES FOR ALUMIN

… PAINT ON WOOD

PA… ARACTERISTICS

ALU… · TESTING THE

VEHI… PAINT ON BRICK

TESTIN… STEEL · DRYING

TIME · …M · SPRAYING

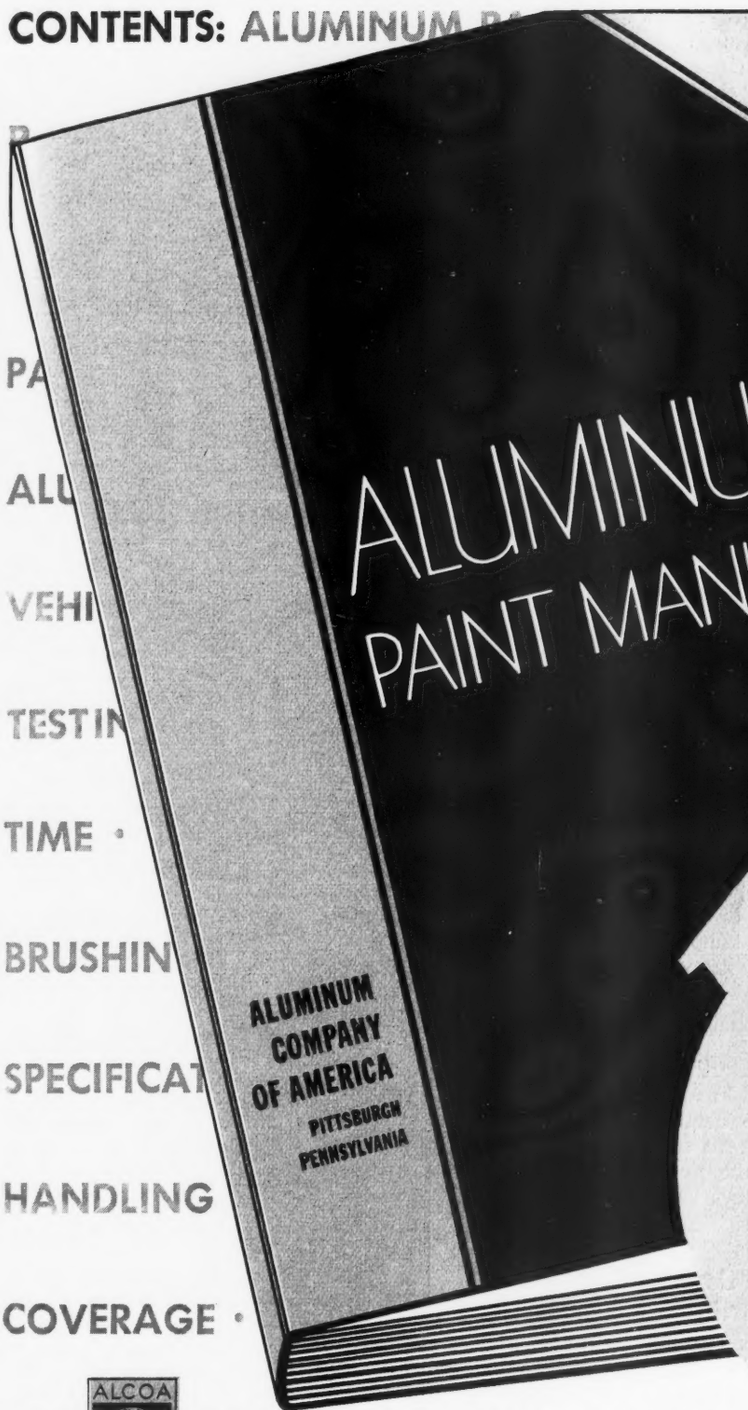
BRUSHIN…

SPECIFICAT…

HANDLING

COVERAGE ·

PAIN… FORMULAS FOR ALUMINUM …XING



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Boxes, cartons (corrugated and fibre), bundles, skids, bales, and packages of all kinds are reinforced to stand heavier shocks with lighter materials under Signode packing methods. The shipper and the consignee both gain through lower costs, but the shipper earns added good will.

● What shall it profit a manufacturer to spend time and money developing sales-stimulating package . . . if it arrives at its destination looking as sloppy as a water-front hobo?

Says A. L. Green, Freight Claim Div. Assn. of American Railroads: "The shipper who does not know what proportion of his shipments is reaching customers in non-salable, non-usable condition is neglecting an important source of dissatisfaction and possible loss of business."

Learn how and why packages protected with Signode Steel Strapping reach their destination as neat as West Point cadets on parade. Signode Steel Strapping protection does more than safeguard packages and merchandise. It cuts packing and shipping costs as well. Write for facts on Signode advantages.

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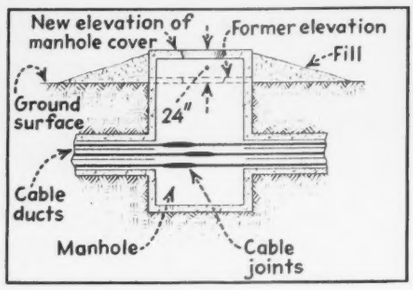
361 Furman Street, Brooklyn, N. Y.
452 Bryant Street, San Francisco, Calif.
Grant Building, Pittsburgh, Pa.

SIGNODE
Tensional Steel Strapping

holes, there is always danger of a service interruption should there be a fault in the cable sheaths, joints, or installation. In addition to this hazard, the cost of removing the water and cleaning manholes and cable ducts may reach a sizable figure.

In one large plant so much trouble was experienced with water and



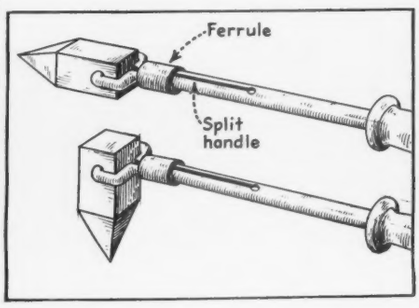
its removal that all manholes subject to flooding were raised at least 24 in. above the ground surface. Unsightliness in landscaped areas was avoided by filling around the raised portion and re-sodding. Where manholes were located near roadways the fill was made sufficiently dense to avoid danger to the manhole walls from carelessly driven trucks. As manholes and ducts were of waterproof construction this procedure entirely eliminated all trouble from unusual moisture conditions.

Don't forget that welding torches have open flames and can't be used in hazardous locations where combustible gases or fumes are present.

Solder Copper Swivels for Hard-to-Get-At Places

C. H. WILLEY, *Penacook, N. H.*

Maintenance men will be interested in the idea applied to the soldering copper shown here. The copper was made from a square



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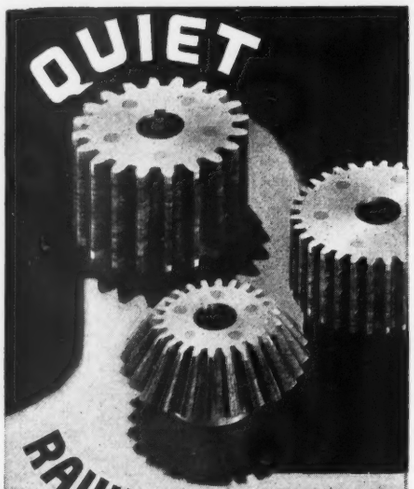

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What "floating power" is to automobiles, what shock absorbers are to the chassis, Chicago Rawhide Gear and Pinions are to power drives. They end destructive vibration and chatter, silence "grinding" and *take all the wear* when meshed with metal gears. Dielectric—they prevent "grounds" and prevent accidents.

Available in all sizes, all types and all standard pitches.

Send for New Gear Catalog, showing metalic and non-metalic Gears.

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FARVAL GIVES *Exactly Enough* LUBRICANT

● Adequate lubrication is *balanced* lubrication. Regardless of size, type, or number of bearings in your production machines, the Farval System will deliver the exact amount of lubricant to each—serving all and missing none, no matter how remote.

The Farval Centralized System of Lubrication protects against repair and replacement, by maintaining an adequate film of lubricant on the bearings at all times. It reduces the labor of oiling, prolongs life of equipment, and insures continuous production.

You are invited to write for complete information and technical data. The Farval Corporation, 3256 East 80th Street, Cleveland, Ohio.

Affiliate of The Cleveland Worm & Gear Co., Manufacturers of Automotive and Industrial Worm Gearing

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Special Delivery to Every Bearing

Stops fire IN ITS TRACKS

. . . keeps production lines moving

● LUX carbon-dioxide snow-and-gas instantly kills fire. It is the fastest known extinguishing agent.

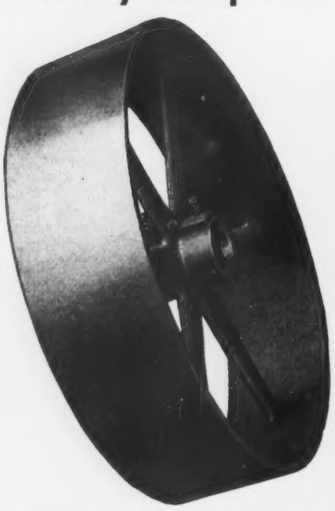
Yet Lux is so clean, so harmless, that there are no after-effects. No mess to be cleaned up. No dangerous fumes. So you resume production immediately. *Lux saves hours on the production line.*

Here, then, is your extinguisher for industrial fires—a Lux portable for ordinary hazards—a Lux Fixed System for a serious concentrated hazard, or to protect valuable or delicate equipment.

Write for new brochure, "LUX Makes The Difference."

Walter Kidde & Company, 62 West St., Bloomfield, N.J.

Not only *our* opinion . . . but *THEIRS!*



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Invariably *cast iron* pulleys have proved to be the best investment. Comparison shows them truer-running . . stronger . . more enduring under even the most exacting service conditions. And experience shows that

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machine-moulded from finest metals and carefully machined, are more uniformly power thrifty on any drive. A sure bet for a "smoother run for your money".

Modestly we agree—by going back to our original premise that Cast Iron pulleys are far superior. That has always been our contention . . . and it is borne out by the FACTS. Facts, incidentally, which are freely yours to examine if you'll write—

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copper bar and a hole drilled in it to take a special forked handle, split, and held by a sliding ferrule. Points projecting from the two prongs of the handle fork were rounded for the hole in the copper, and the bends were made fairly square to keep the copper firmly clamped. This has been found to be an extremely handy tool.

Questions and Answers

Inspecting Control Equipment

Some of our control equipment has recently given trouble which seems to be due to lack of attention. I want to put control inspection and maintenance on a more definite basis, and wish that readers would tell me how often they inspect controls, and the routine they follow.

Most of our motors range from 2 to 5 hp., 440 volts, three phase, and are controlled by pushbuttons through across-the-line starters. Larger motors have compensators, mostly hand-operated. Six motors have full automatic starters which are operated by pressure switches. Service conditions are about the same as found in the average plant.

—D.McD.

WHEN CONTROLS have been properly selected for the service, they will operate satisfactorily with a minimum of attention. An inspection once a month should be sufficient, as a rule.

With air-break, across-the-line starters the inspector should:

1. Check contacts to see that all make good contact, with the proper pressure, that they are correctly aligned, and that shunts to moving parts are in good condition. Renew badly worn or burned contacts.

2. See that all terminals are tight.

3. See that moving parts move freely. On hinged parts a drop of oil will reduce wear.

4. Blow out any accumulations of dirt or dust.

5. Check the shading coil in the magnetic circuit for an open circuit. An open shading coil causes vibration, resulting in burned contacts, and may cause a burnout of the operating coil.

6. Check pushbuttons to see that they make good contact.

7. Once a year replace all worn parts, and make an insulation resistance test.

On hand-operated compensators:

1. Check the contacts to see that all make good contact, with sufficient pressure. Renew worn or burned contacts. Examine shunts for breaks and loose connections.

2. Check all terminals to make sure

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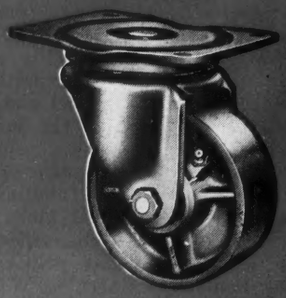

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Ball Bearing Steel Swivel Casters. Economical and strong.

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Whatever your need, you will find a Bassick caster that will fill it. The casters illustrated are merely samples from the complete line of Bassick truck casters consisting of over 450 different types and sizes.

Bassick factory representatives and distributors are at your service to assist you in helping solve your truck caster problems.

Complete Truck Caster Catalog Sent on Request

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Canadian Factory:
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SERIES "77"
A Special 10" Caster for Power Trailers and Heavy Loads.

SERIES "77"
Two Level Ball Race Construction. The Ideal General Service Casters.

SERIES "61F"
Steel Casters with Female Threaded Plates.

BIG TOOL VALUE AT SMALL TOOL PRICE
Walker-Turner offers this tool to prove it. And tells you how it's done . . . Years devoted to a single type of work. Intensive research and production studies. Specialized engineering. Complete plant facilities . . . All concentrated on SMALL POWER TOOLS ALONE. Result—the biggest tool values available today.
16" BAND SAW $96.25
Does not include motor, mitre gauge or base.
SUITABLE FOR ALL-AROUND WORK

Walker-Turner BN1125 Band Saw is the ideal tool for plant construction and maintenance jobs because of its capacity for work of any size, any variety of cut, plus its unusual safety, strength and precision. These features are important—you'll find them all in the Walker-Turner BN1125 model!

1. **CAPACITY**—Blade to frame 16". Upper guide to table 12". Twenty-nine thousand feet of saw teeth a minute slice through thin stock or "hog" their way through big beams or sheathing.

2. **VARIETY OF CUT**—Rips straight parallel edges any length by use of the adjustable fence. Exact angles measured by the mitre gauge. Arcs, circles, and scrolls as fed. Bevel cuts, any angle to 45°, by the patented table tilting device.

3. **SAFETY**—Complete wheel guards, back blade guard, front telescoping guard. Blade is always covered.

4. **STRENGTH AND PRECISION**—Rigid frame, one piece hollow cast; balanced wheels faced with rubber; ½ h.p. capacitor start motor required; ball bearings on shafts and guides.

Ask your nearest Walker-Turner distributor for a demonstration, or write for descriptive bulletin. Walker-Turner Co., Inc., 33127 Berckman St., Plainfield, N. J.

WALKER-TURNER
Engineered **POWER TOOLS**

that they are tight and show no signs of heating.

3. Check the contacts of overload relays to make sure that they are clean and make good contact. Make sure that dashpots operate freely, have sufficient oil in them, and that they are set to the proper rating for the motor.

4. Check the holding and shading coils.

5. Blow out all dust.

6. With normal operation, not to exceed four or five starts an hour, the oil should be renewed once a year. If there is no moisture in it, the oil may be treated to remove the carbon particles and most of it used over again.

7. When changing the oil, wash all parts of the switch with clean oil to remove carbon particles, which may cause trouble.

8. Once a year check the trigger release mechanism and renew any parts showing excessive wear. Also examine the auto-transformer thoroughly and give it an insulation resistance test.

There are several types of automatic starters for both squirrel-cage and slipring motors; therefore it is difficult to say just what points should be watched for trouble. The automatic compensator is much the same as the hand-operated starter, except that a relay is used to control operation and magnets do the switching. The relays, whether time delay or current limiting, usually operate without trouble if they are kept clean and properly adjusted. In general, when inspecting these starters the same points should be watched as in the case of the hand-operated kind.

In this kind of work, experience is one of the best teachers. By familiarizing himself with the special kinds of controls under his care, an inspector will soon learn just what points to watch for trouble.—CHAS. W. WARD, *Kansas City, Kan.*

ELECTRICAL trouble with motor starters can usually be divided into two classes: main line trouble and control trouble.

Main-line circuits may be considered as including the main switch, main fuses, and the motor contacts in the starter. Assuming that the main switch and starter are of sufficient capacity, heating at the main switch is probably due to poor contact at the switch or fuse jaws.

Starter contacts can be checked by closing them by hand and making sure that all contacts close at the same time and that spring tension is firm and equal.

Control circuits include the start buttons or control switch, overload relay contacts, operating coils, and any safety or limit switches that may be in this circuit. The inspector should make sure that the pushbuttons are rugged enough to stand the abuse they get. Some operators seem to think that the

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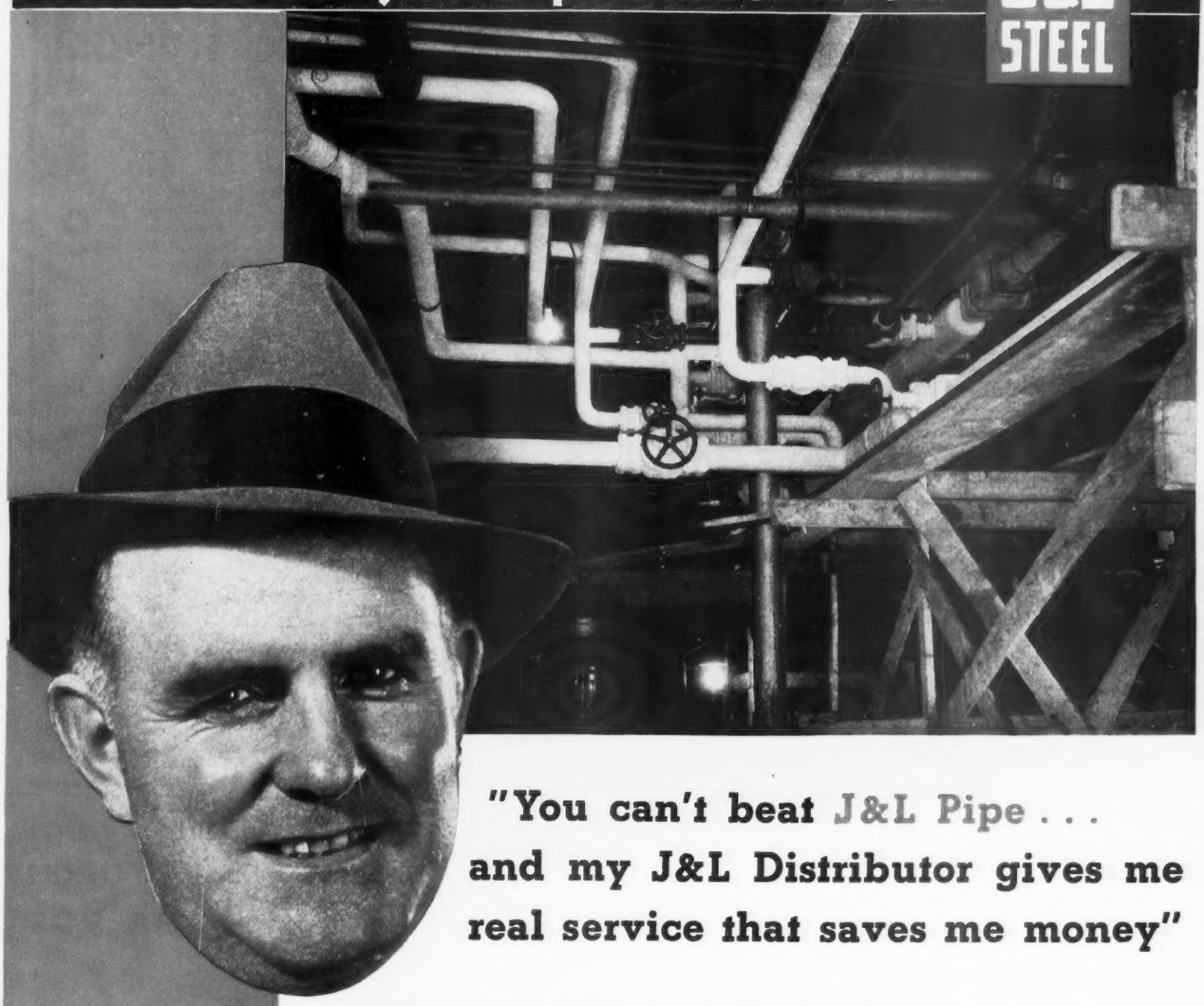

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You, too, can save time and money . . . get better pipe that brings you more customers . . . and increase your profits through better work . . . better looking jobs. Buy J&L Pipe . . . from your J&L Pipe Distributor.

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● Executives, factory managers, engineers, production managers and plant superintendents—all interested in the latest equipment designed to meet the demands of better working conditions and satisfy the exacting requirements of present day industrial operations are looking forward to an important forthcoming event—the Fifth International Heating & Ventilating—Air Conditioning—Exposition.

● Thousands are planning to take advantage of this timely opportunity of studying the impressive displays of the nation's leading manufacturers of heating, ventilating and air conditioning equipment.

YOU AND YOUR ASSOCIATES SHOULD CERTAINLY ATTEND.

Held under the auspices of American Society of Heating and Ventilating Engineers. Managed by International Exposition Company.

harder they press the button the greater the power delivered by the motor. Hence, the contacts become bent and give trouble.

Next, are the overload relay contacts properly adjusted? Is the operating element of the proper size? Where dashpots or other time delays are used, are they properly set?

Check the line voltage across all phases while the plant is operating under normal load, and see that the voltage is balanced.

Standard makes of starters properly installed with correct auxiliary equipment will operate for months without repairs or inspections. With larger units, say from 25 hp. up, more frequent inspections are required. Local conditions influence the matter of electrical maintenance so much that no one plan is applicable to all plants.

The most important requirement of all is to have an experienced electrical maintenance man, not a construction man, in charge of this work.

GILBERT LINDGREN
Electrical Foreman
Hudson Valley Fuel Corporation
Troy, N. Y.

Service Records for Plant Supplies

Many miscellaneous items, such as belting, drills, hose, and abrasive wheels are used in our plant. We should like to compare the system we use for determining the quality and the service obtained from such items with the methods used in other plants. Any information you can give us on this subject will be much appreciated. —J. A. J.

BREAKDOWN tests are usually conducted on different types of materials to determine which of the many brands offered give us the most economical service, considering the matter from all angles. For example, we have in our files many engineering reports on abrasive papers and cloths, twist drills, pumice, silica, abrasive wheels, chrome-plated tools, pump sleeves, and so on. After these tests have been conducted we make definite recommendations to the purchasing department, and purchase specifications are drawn up, indicating the types and brands wanted. In some cases, as with belting, it is necessary to keep service records over a period of months to determine the length of life, number of patches required, and so on. The time varies, of course, depending on whether the belting is used under wet or dry working conditions.

We run control tests on a number of purchased materials: that is, each lot is checked against certain specifications. A large laboratory is maintained both for control tests and for research work.

WM. C. MULLEE
Standards Department
American Hard Rubber Company
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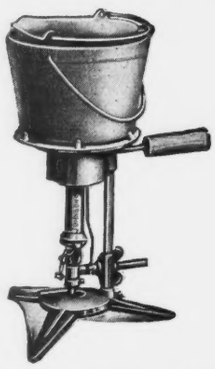
Pyroil has a record for efficiency that tells its own, quite remarkable story. It has been the means of saving expensive equipment where damage was imminent. It has overcome deficiencies that held back production schedules. It has stepped up production and cut down labor. It has brought about decided economy in its use and application in innumerable instances.

Put Pyroil to most any test, severe or otherwise. Use only a few ounces at a time. See what it does.

Our laboratory is at your service for counsel or advice on any lubrication problem. Pyroil Company, 525 La-Follette Ave., La Crosse, Wisconsin, U. S. A.

JOHNSON NO. 8 ADJUSTABLE TORCH AND MELTING POT



This is a powerful torch for Metal Workers or any General Shop or Laboratory use. A highly efficient and economical unit for soldering, tempering, pre-heating or metal melting. The pot and shield can be instantly removed. The Johnson No. 5 Type "A" Burner is adjustable to any angle or can be removed and used as an efficient hand torch. No forced air blast required for quick, intense heat. Write for free catalog on this outstanding Johnson unit.

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Cedar Rapids IOWA

Power

to Cut Assembly Costs

WHETHER your assembly operations require driving small screws, or tightening large nuts—there's a Van Dorn Electric Screw Driver or Nut Runner which will handle the job more efficiently—will be less fatiguing to the operator. Why not check over your assembly operations now? Then ask your Van Dorn Jobber to show you, right in your own plant on your regular work, the savings you can make through the use of Van Dorn Screw Drivers and Nut Runners. Or write for catalog. The Van Dorn Electric Tool Co., 719 Joppa Road, Towson, Maryland.
(Div. of Black & Decker Mfg. Co.)

FOR POWER, SPECIFY

"Van Dorn"

The Red-headed

PORTABLE ELECTRIC TOOLS

GIVE THEM

DUFF-NORTON Jacks

THEY'RE SAFER!

THEY'RE EASIER TO OPERATE!

THEY'RE TIME SAVERS!

Duff-Norton Low Height Screw Jack No. 5017 with foot lift for very low loads.

You will find it profitable to replace your old obsolete lifting equipment with new up-to-date Duff-Norton Jacks —the last word in lifting efficiency and safety—the line of jacks that are perfected by over 50 years of progressive specialization. With their improved aid your men will really get things done quicker and safer. Ask your local Mill and Mine Supply Dealer about it today.

4-Way Chain Jack No. 1523 combines head lifting, chain lifting and claw lifting. Capacity 15 tons. Hinge or pivotal base permits shoving and pushing applications.

Duff-Norton Ball-Bearing General Purpose Jack Type C-35 in 15 to 35 tons capacity.

THE DUFF-NORTON MANUFACTURING CO.

"The House That Jacks Built"

PITTSBURGH, PA.

Sayings and Doings

"Getting Along With" Doesn't Mean "Defeat"

Reporting to the Third National Convention of the Federation of Architects, Engineers, Chemists, and Technicians, a CIO affiliate, Secretary Jules Korchien said: "Employers' magazines such as *Factory Management and Maintenance* are replete with instructions of how to defeat legitimate unions, to set up company unions that will meet the requirements of the law and even appear to enter into collective bargaining to defeat the legitimate demands of the employees. We quote from a set of rules on collective bargaining published by *Factory*, '. . . be friendly in negotiations. Introduce everybody. Relieve any existing tension. Be willing to listen. It is time enough to worry about how you will say "no" after you have heard the facts.'"

This quotation was taken by Mr. Korchien from the article "Getting Along With the Union," published in the issue of August, 1937. It is part of a set of twelve rules on collective bargaining developed and used by a well-known rubber concern. So far as the editors can see, these rules are neither pro-organized labor nor anti-organized labor. They are just common-sense rules for carrying on meetings between employers and the representatives of organized labor in a peaceful, constructive, resultful fashion. If all of the rules had been quoted, this would have been apparent.

Penn Factories May Get Adjustment

Industries experiencing "undue hardship" under Pennsylvania's new law fixing a maximum 44-hour work week for women, may petition the State Industrial Board for approval of a modified working schedule.

The general provisions of the law are that no woman shall work more than 5½ days a week, or more than 44 hours a week, or more than 8 hours in any one day. The 8 hours of work in one day must be performed within 10 consecutive hours.

Women must not work more than 5 continuous hours, and there must be at least a 30-min. rest period. In manufacturing industries, no woman may work before 6 a.m. or after 10 p.m., but this does not apply to managers, superintendents, or persons doing clerical or stenographic work.

For the guidance of employers the

Fact No. 1. **Your contract for your plant lubrication is perhaps a type of insurance policy assuring you of correct lubricants, properly applied, and insuring against inefficient operation, excessive repairs and costly shut downs.**

Fact No. 2. **You can be sure of getting the correct lubricants, and you can be sure of their proper application by calling in a Pure Oil Industrial Engineer. He will scientifically survey your plant and gladly make the necessary recommendations.**

THE PURE OIL COMPANY U.S.A. PURE THREE POINT SERVICE INDUSTRIAL DEPT.

Comprising Pure Oil's Three Point Service is:

1. Selected Crude. 2. Skillful Refining and 3. Scientific Application.

THE PURE OIL CO.

U. S. A.

PRODUCERS, REFINERS, MARKETERS OF A COMPLETE LINE OF PETROLEUM PRODUCTS

HEAR CLEARLY

INSTALL BURGESS BOOTHS AND BLOT OUT NOISE

● Install a Burgess 201 Acousti-Booth and see how it improves the phone service so important to efficient management. Booth 201 is lined with world famous Burgess ACOUSTI-PAD. This absorbs noise and lets you hear clearly no matter how heavy the din. Booth 201 is of open construction for cleanliness and ventilation. It is steel built for ruggedness and long life.

Burgess Acousti-Pad absorbs noise in Model 201 phone booth so you hear clearly and easily.

TRIAL TEST OFFER

Good phone service is worth money. That is why you should find out about Burgess 201 Acousti-Booth. Write for the Trial Offer and Bulletin 126. Send the coupon today!

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State Industrial Board issued these general regulations:

1. Half day shall be 4 hours; but if woman employee works less than 44 hours in a week, half day shall be 5 hours.

2. Woman employee may work 6 consecutive hours, provided she is dismissed for the day at the end of that time and also provided there is a 15-min. rest period to break the continuous work period. Six days of 6 hours each will constitute a week.

3. Employees working only 5 days in 7 may work 9 hours in any one day, provided the weekly total does not exceed 44.

4. Where variations from the standard maximum hours are allowed by the State Industrial Board, such variations shall not apply to girl workers under 18 years of age.

Employers who had made contracts with unions under the collective bargaining provisions of the Wagner Act, prior to September 1, are permitted to continue with the contract hour and work schedules until the contracts expire.

Violations of the 44-hour law for women are punishable by fine and imprisonment.

•

York Doubles Insurance

A new life insurance plan, doubling the amount of insurance for hourly wage earners, has been accepted by more than 90 per cent of the employees of the York Ice Machinery Corporation, York, Pa. At present, more than 3,000 York employees located throughout the world are covered by the company's insurance program, which amounts in total to almost $4,000,000.

Each wage-earner's policy has been raised from $500 to $1,000, and it includes also sickness and accident benefits. The company pays a substantial portion of the cost of the insurance. A total of 1,853 hourly workers filed applications and were accepted under this new plan; 1,242 salaried employees are covered under a somewhat similar arrangement.

•

550 Years Without An Accident

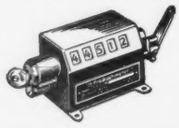
Time was when we regarded the home as an essentially safe place and the factory as a fundamentally dangerous one. We knew that manufacturing plants were filled with whirling wheels or burning metal or sharp-edged tools all accentuated by dirt and darkness, and in consequence the workmen in the factory might be expected to suffer a considerable amount of bodily injury, willy-nilly.

These things we used to think. Some of us still do. And yet with the cold facts at hand we must change our thinking because, to the amazement of

Are Your Machines Running Blind?

A man driving a car blindfolded is no more uncertain about where he is going to wind up than is a punch press or any machine operator getting out an order without a counting instrument. The counter dials are the eyes of the machine; they tell the operator every second just where he is. *Productimeters* pay their cost daily in saving over-runs, under-runs, and time wasted by hand counting.

DURANT MFG. CO.



1918 N. Buffum St.
Milwaukee, Wis.
176 Eddy St.
Providence, R. I.
Sales Offices in all Principal Cities

TELL US WHAT YOU WANT TO COUNT

CHARAVAY FANS

THE OLDEST NAME IN PROPELLER - TYPE VENTILATION

for

- Plant Ventilation
- Man Cooling
- Materials Cooling
- Materials Drying
- Heat Dispersion
- Dust Control
- Fume Dispersion
- Air Circulation
- Home Ventilation
- Mine Ventilation
- Unit Heating

WRITE FOR FACTS!

HARTZELL PROPELLER FAN CO.

ORIGINATORS OF
Propeller-Type Ventilation
WALNUT ROAD, PIQUA, OHIO
Sales-Engineering Offices Everywhere

IMPREGNABLE!

In the Allis-Chalmers Seal-Clad Motor the wound stator receives impregnating treatment, similar to the conventional type of winding. Then a Moulded Shield of high dielectric and mechanical strength is fitted into a machined slot in the stator frame and tightly sealed into position with a special compound—thus giving complete protection to the coils.

This feature makes Allis-Chalmers Seal-Clad Motors impregnable to metallic dust, grit, oil, moisture, chemicals and other agents destructive to motor windings.

One or more of these destructive agents are present in every plant, to a greater or lesser degree . . . so why take a chance?

If your plant conditions are severe, the ultimate in motor protection is essential to you—Allis-Chalmers Seal-Clad Motors offer the ultimate in motor protection. If your plant conditions are not so severe as to make this protection absolutely essential, Allis-Chalmers Seal-Clad Motors are still the soundest investment you can make, BECAUSE YOU ARE GIVEN THIS GREAT ADDITIONAL PROTECTION AT NO ADDITIONAL COST.

For further details, write today for Leaflet No. 2182.

The Allis-Chalmers Mfg. Co. builds standard motors of every type from 1 hp. up—also motors for special application.

794

MOTOR DIVISION

ALLIS-CHALMERS

MILWAUKEE WISCONSIN

A CONVENIENT SERVICE

SHIPMENTS of brushes within 24 hours! That's the service offered to plant managers through the 75 warehoues of the Pittsburgh Plate Glass Company.

Why not take advantage of this service? Concentrate your brush purchases in this one reliable source of supply.

There is a "Pittsburgh" warehouse near you—carrying a complete stock: Gold Stripe brushes for all types of paint jobs, both maintenance and production, also floor sweeps, mill dusters and many types of wire scratch and casting brushes.

Refillable Spiral Wound Brushes of wire, horsehair and tampico can be furnished on special order for large scale production.

Write today for free illustrated catalog. State whether interested in brushes for maintenance or production, and what the problem is. We will gladly place our engineering staff and service facilities at your disposal.

PITTSBURGH
PLATE GLASS COMPANY
BRUSH DIVISION · BALTIMORE, MD.

BRISTLE, WIRE AND TAMPICO BRUSHES FOR EVERY INDUSTRIAL NEED

many, we can draw no other conclusions than that the worker in the average industrial plant is in about the safest place that he could be.

Let us consider a typical industrial group, the factories of the Lamp Division of the Westinghouse Electric & Manufacturing Company. Here in three factory properties employing a total of some 3,650 men and women engaged in a wide variety of manufacturing operations, the total number of disabling accidents in 1936 was 5.

Taking into account the hours of labor we may note that the "frequency rate" of disabling accidents was 0.87 for each million man-hours worked. In short you or I as an individual might expect to work considerably more than 1,000,000 hours in the Westinghouse factory before we could (by the law of averages) experience a seriously bodily accident. On the basis of the 35-hour week this means 38,571 weeks—550 years!

Samuel G. Hibben
Director of Applied Lighting
Westinghouse Lamp Division

•

Employees Drive Automobiles to Work

More than 30 per cent of the employees of the Schenectady Works of General Electric Company now drive automobiles to work, as compared to less than 12 per cent in 1929.

There is now one car for every 3.3 employees, while figures for 1929 showed one car for every 8.8 employees. During the peak years of 1928 and 1929, when number of those employed in the works and offices totaled more than 30,000, the greatest number of cars parked was 3,600. At the present time, with about 18,000 employees, or 44 per cent less than in 1929, the number of cars parked is 5,500 each weekday.

The increase has necessitated an enlargement of the parking spaces to nearly twice that of 1929 and a one-way traffic system to handle the movement of cars during the hours of going to and coming from work.

•

Metal-Working Comeback Only Partial

In 1935 *American Machinist* took a count of metal-working equipment rated according to age. The result showed that 65 per cent of 1,345,447 machine tools in use by American industry were over 10 years old. Previous surveys gave corresponding averages of 44 in 1925 and 48 in 1930. (See *Factory* for June, 1935.)

It was estimated then that the machine-tool industry would have to operate on an index level of 107.3 (1926 = 100) over a 5-year period to maintain its ratio of 65 per cent of

(*Continued on page* 142)

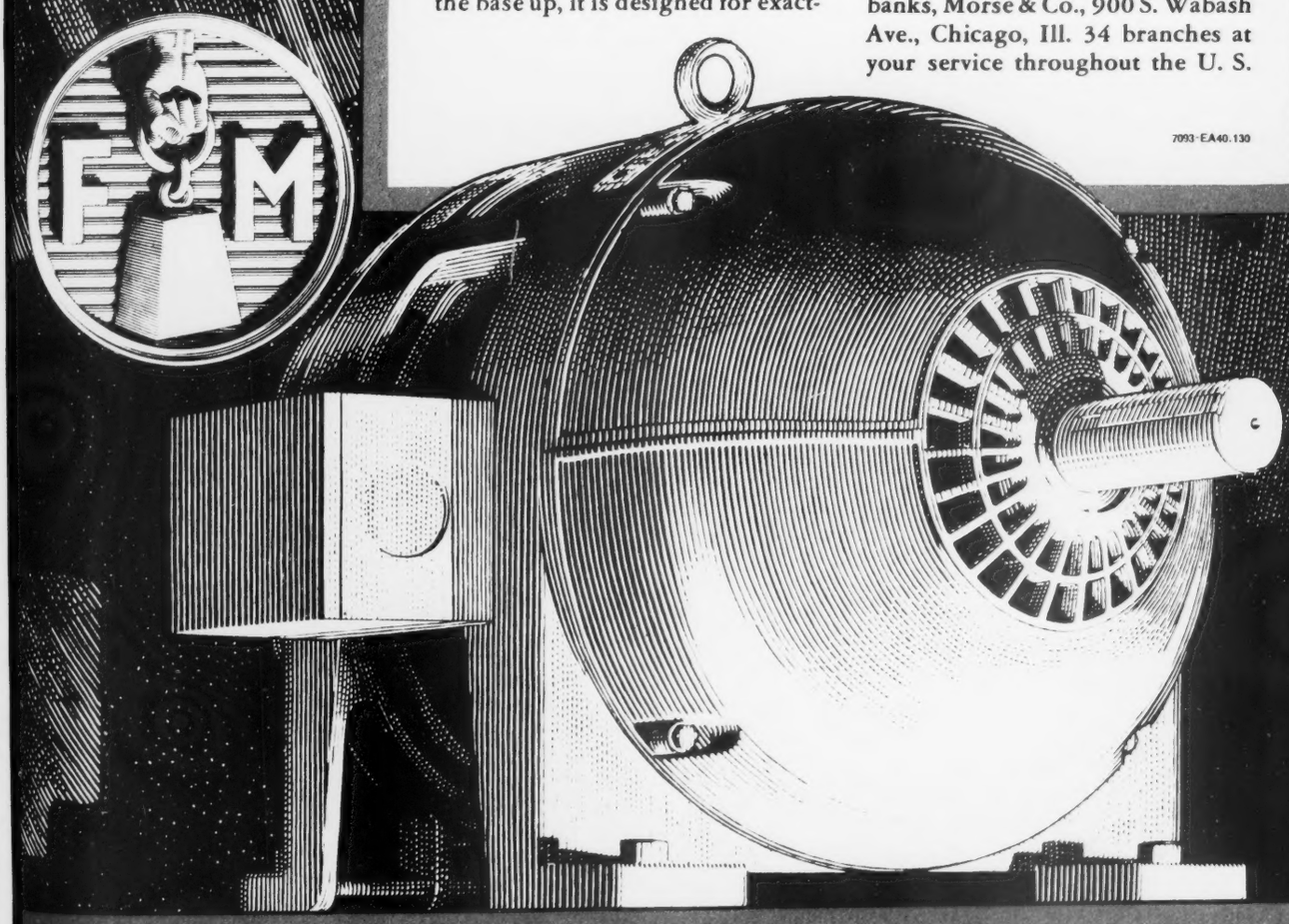
A MOTOR THAT WILL LIVE IN THE "*Sand Storms*" OF YOUR FINISHING DEPARTMENTS

Wherever there are "sand storms" . . . in grinding and sand blasting departments for example . . . the ordinary motor is soon cut to death. It is soon eaten up, wherever there are corrosive fumes. At such deadly work, a Fairbanks-Morse enclosed fan-cooled motor will live . . . long and economically.

The F-M enclosed fan-cooled motor is far more than an ordinary motor with a dust-tight case. From the base up, it is designed for exacting service. Fortified by a vault-like case which dust and fumes do not penetrate, it is ventilated and positively cooled by fans at each end of the shaft. Ball bearings reduce friction to the vanishing point, and bearings need lubrication only once a year. These and many other protective features are incorporated within a size no larger than a regular open-frame motor.

Write for Bulletin 1113, Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. 34 branches at your service throughout the U. S.

7093-EA40.130



FAIRBANKS MORSE

DIESEL ENGINES
PUMPS
ELECTRICAL MACHINERY
FAIRBANKS SCALES
RAILROAD EQUIPMENT
WATER SYSTEMS
REFRIGERATORS
RADIOS
WASHERS
FARM EQUIPMENT
STOKERS
AIR CONDITIONERS

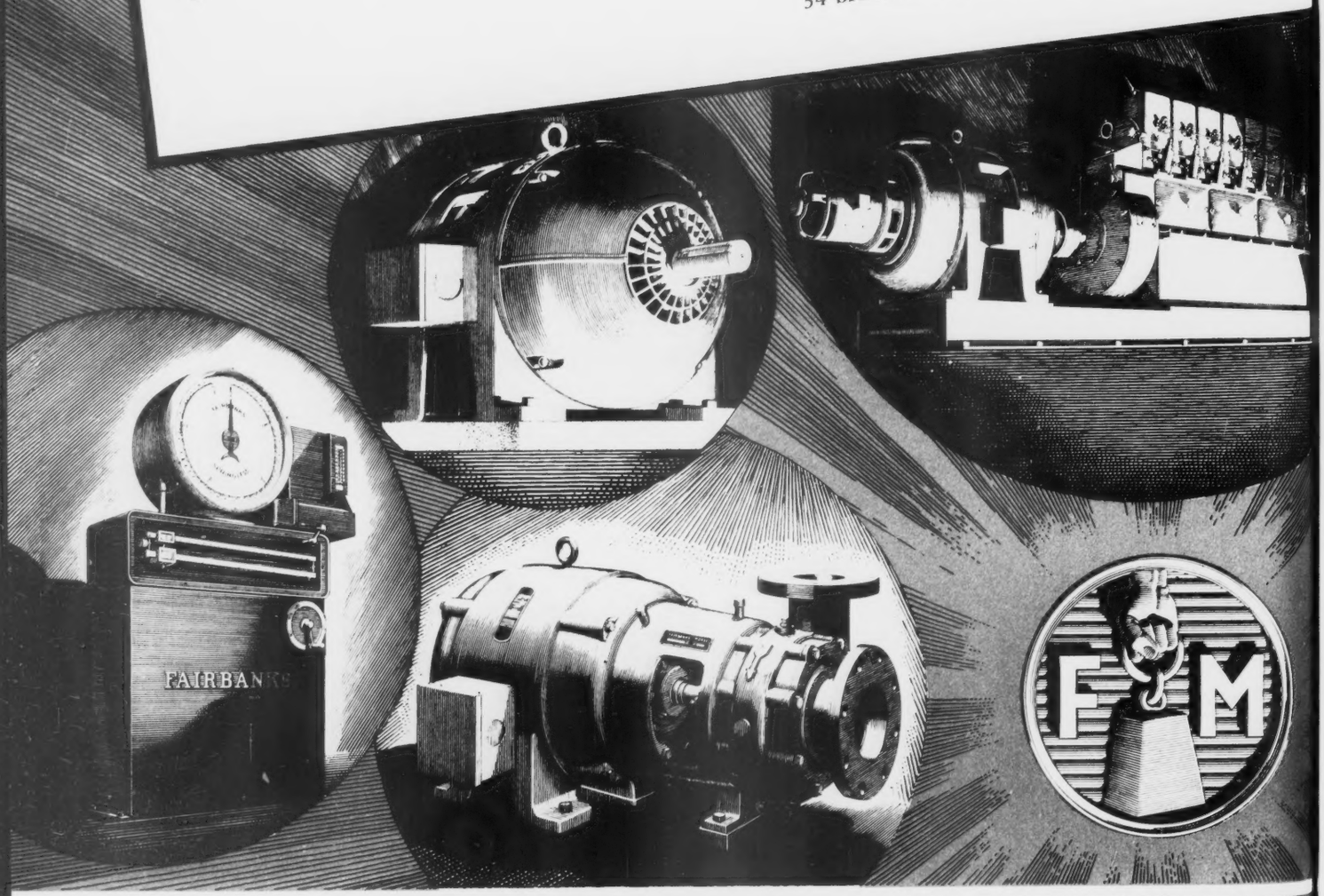
Motors

YOU CAN RELY ON A

Habit of Quality

Organizations develop habits just like individuals. The habit of careful manufacture is of 107 years' standing with Fairbanks, Morse & Co. The first product of the family was scales, a product which must be accurate or be next to useless. Fairbanks scales and other early products were pioneers in a world where knowledge of machinery was rare. They had to be designed simply and built sturdily to perform and last in unskilled hands. Even later F-M products . . . Diesels and electric motors, for example . . . were pioneered while knowledge of such products was not widespread.

Such a background of precision manufacturing and painstaking analysis of operating conditions is valuable to you in choosing scales, Diesels, motors, or pumps. Write for literature on the kind of equipment you require. Address Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. 34 branches at your service throughout the U. S.



FAIRBANKS – MORSE

Power, Pumping, and Weighing Equipment

107 YEARS OF PRECISION MANUFACTURING

When a V-Belt Bends

IT Changes SHAPE

That's the REASON for the

Concave Side.

Any V-belt **changes shape** when it bends. The top is under tension and **narrows.** The bottom, under compression, **widens.** Figure 1 (below) shows the resulting shape-change in a straight-sided belt. Note the out-bulge of the sides.

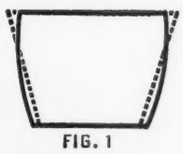
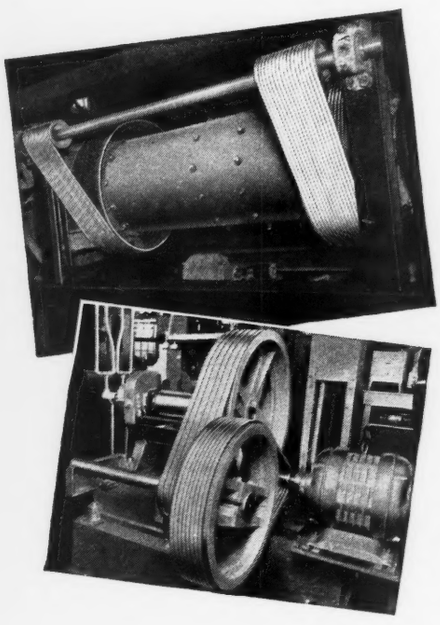


FIG. 1

WHAT HAPPENS WHEN A V-BELT **BENDS**

FIG. 2



Now look at figure 2. The same change of shape merely **straightens** the concave side, producing a contour that **precisely** fits the sheave groove.

Two big economies result: (1) No out-bulge at the side means uniform wear—**longer life!** (2) Full side-wall grip on the pulley holds heavier loads without slippage—a big increase in drive efficiency—saving belt wear and also saving **power!**

The Gates Vulco Rope is the only V-Belt built with the patented concave side.

Engineering Offices and Stocks in All Large Industrial Centers

THE GATES RUBBER COMPANY

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GATES VULCO ROPE DRIVES

(*Continued from page* 138)

old equipment, and would have to step up activity to 179 in order to regain its lost ground and bring the percentage back to 48, which was reported in 1930.

During the 2½-year period that has intervened, the industry actually operated at 131.

During 1935 the machine-tool index of orders was 86 per cent. In 1936 it was 136.6, and during the first six months of 1937 it averaged 210. If the latter level is continued through the last half of this year and through 1938 and 1939, the over-all average for 5 years will be 170.5, still somewhat under the estimated index required to restore the 1930 ratio.

All this seems to indicate that in spite of the current high level of machine-tool production the metal-working industry has came back only a short way on the road to rehabilitation of its shops. It indicates that it is a long hard climb for any industry to regain physical efficiency that has been neglected for so long a period of time. It points to the necessity of maintaining modernization programs at a high level in order to put metal-working plants on an efficient basis for peace-time operation and in readiness for national defense.

DUE to the use of material handling equipment, American Workers have been able to produce more, with less fatigue, earn more, and therefore purchase more quality goods at a lower cost than any other group in the world—and American Manufacturers have profited accordingly. The Jervis B. Webb Company do their bit toward contributing to American prosperity by manufacturing every type of conveyor—each designed to assure maximum service and efficiency. Our engineers are always available and eager to analyze handling problems.

JERVIS B. WEBB COMPANY

Conveyor Engineers and Manufacturers

8951 Alpine Avenue • DETROIT, MICHIGAN

Employees Over 40—Plenty of Them

Inland Steel Company payrolls refute the frequent reports that men more than 40 years of age cannot find jobs in industry.

In October the company employed at its Indiana Harbor plant 4,257 men who are more than 40.

Employees in their forties really are "youngsters" compared to veterans in the company's service. There are 27 employees between 70 and 77 years old.

Another 57 are more than 65, the retirement age under the social security program. There are 3,002 workers between 40 and 50 years old, and 1,015 between 50 and 60. Between 60 and 65 there are 156 others.

The total of Inland employees more than 40 years of age constitutes 32.7 per cent of the 12,998 employed in October.

•

Industry Answers Those Who Challenge It

The following broad declaration of principles, calling for the adoption and maintenance of high ethical standards in all operations and laying down a yardstick for such standards, has been submitted by the Committee on Industrial Practices of the National Association of Manufacturers, has been approved by the N.A.M. Board of Directors, and will be submitted for adoption by the Congress of American Industry at its meeting to be held in the Waldorf-Astoria in New York City December 7, 8 and 9:

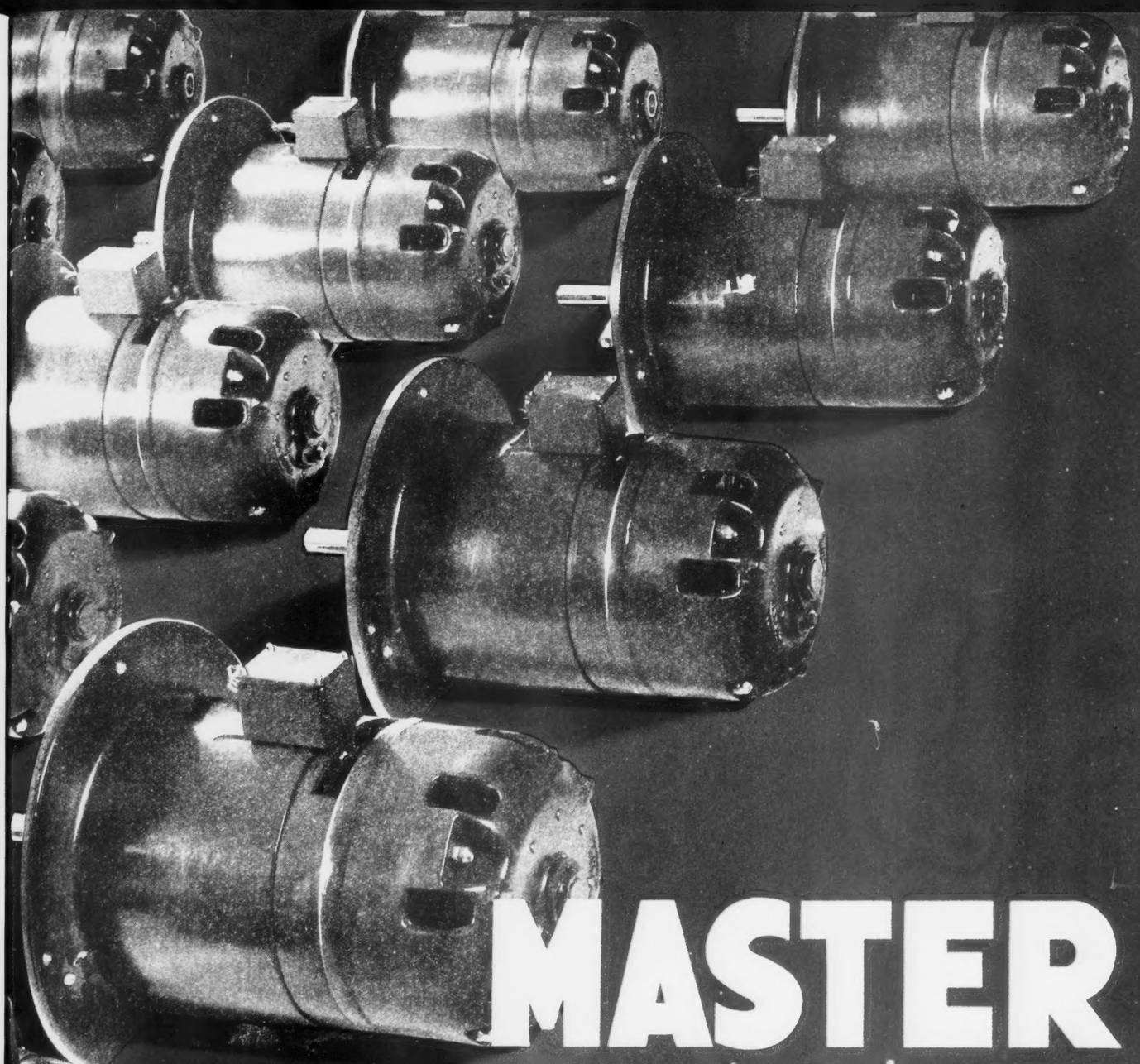
No special plan, formula or procedure has ever been devised in the field of employment relations which can satisfactorily meet the varying conditions and problems of all industries. Each company should develop a sound and well-defined labor policy in the light of its own conditions. Consideration, however, of principles and policies inaugurated by representative manufacturers should assist in the development of satisfactory relations between employees and management. The following principles are typical of successful employment procedures:

1. Free interchange of ideas on all matters and company policies of mutual interest.

2. Scrupulous observance in both letter and spirit of all commitments by the company to its employees.

3. Immediate consideration of all complaints, with opportunity for prompt referring of unadjusted complaints to management through established channels readily available to the employee.

4. A general wage-level at least equal to the wage-level for similar work and conditions in the locality; the wage rate for each job being determined, relatively with other jobs in the plant, with due regard for skill,



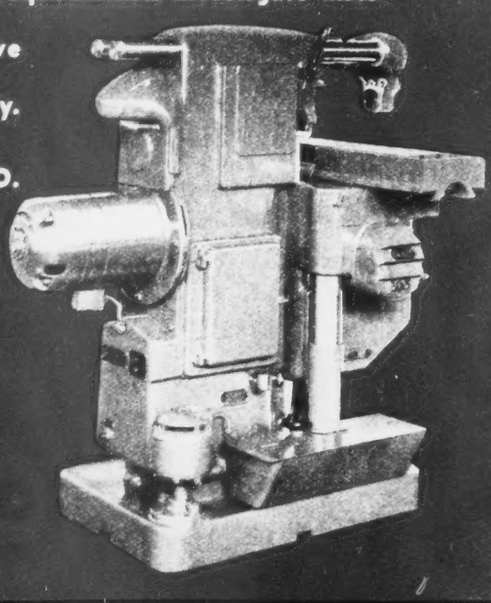
MASTER

makes the job easier

It's easier to secure the advantages of compactness, lowered costs and attractive appearance with MASTER motors built to meet exactly your individual requirements. Investigate MASTER'S unusual ability to serve you promptly and economically.

THE MASTER ELECTRIC CO.

DAYTON, OHIO



responsibility, experience, physical demands and hazards, which the job requires; use of only fair standards of performance which can be reasonably and consistently attained. Adequate wage incentives may be properly used provided such incentives are a reward for individual or group accomplishment. Any wage plan should be sufficiently clear to enable the worker to determine promptly the money due him.

5. Maintenance of good and safe working conditions.

6. A general standard of working hours fully consistent with the welfare and health of employees considering the type of work and providing for seasonal demands or emergencies with an average work day of eight hours and at least one day of rest in seven.

7. In all cases of lay-offs, re-hiring and promotion to non-supervisory positions, consideration should be given to length of service and competency as determined by management, with Seniority the determining factor if several employees are equally competent. In the case of lay-offs and re-hiring, in addition to Seniority and competency, consideration should also be given by management to family status, number of dependents and place of residence; in re-hiring, length of service should only apply for a reasonable time.

8. Dismissal only on just cause with full explanation to the discharged employee.

9. Preliminary physical examinations by qualified physicians of all new employees in order to select and place them on jobs for which they are physically qualified, and also to have a record of their physical condition at the time of entering the company's employ; periodical physical examinations of employees as occupations and working conditions may require.

10. Employment of no person under 16 years of age, or any person under 18 years of age on any job recognized as hazardous; with these two exceptions, age, in all ordinary processes, shall not be a bar to employment.

11. Consideration by employers of the effects of introduction of new processes or machinery on employment; training of workers affected for other work in the plant; giving as much advance notice as possible if termination of their employment is absolutely necessary; and the possible provision of special dismissal compensation related to length of previous service and age.

12. Efforts by management to stabilize employment related to irregularity of work and in this connection the study of annual wages of employees in relation to their hourly earnings and the number of days per year the plant operates.

13. Cooperation with employees in making provision for the needs arising out of death or old age and disability due to ill health or accidents.

•

Long Service Records

More than 40 per cent of the employees of General Electric Company have worked with the company for 10 or more years. Five-year employees number 42,785, while 32,019 have 10 or more years of service.

Oldest employee in terms of service has 54 years of continuous service to his credit.

Fifty-three employees have been with the company 45 or more years; more than 200 for 40 years or more; more than 1,000 for 35 or more; 6,383 are eligible for membership in the Quarter Century Club.

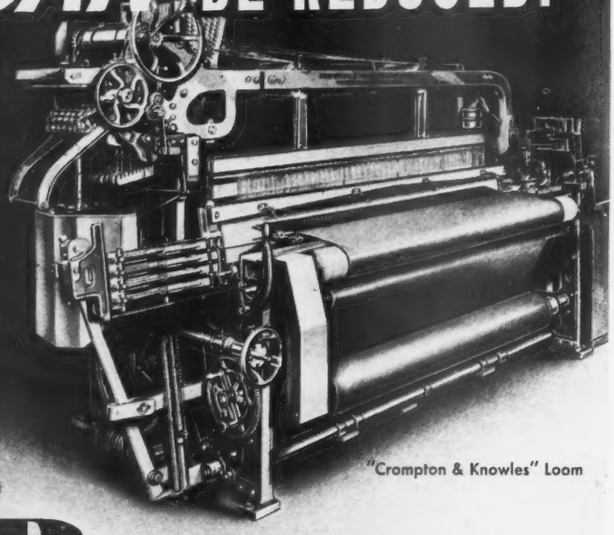
•

Capital and Management

"Probably as misunderstood as any words we use today are 'capital' and 'management'. They are often used interchangeably, while, in fact, they don't mean the same thing at all. 'Capital' is the *savings* that millions of Americans have invested in industry and business. 'Management' is the *people* who are responsible for running the businesses into which these savings have been put.

"Capital is not something abstract. When somebody says 'Capital wants

OIL STAINS... OIL WASTE...
CAN BE REDUCED!



The correct oil film to each individual bearing... automatically

BIJUR
AUTOMATICALLY Correct LUBRICATION

● SPOILAGE annually running into millions . . . Roving, yarn and cloth stained—often ruined—by oil! Yet many progressive mills already have proved that every machine bearing now served by a Bijur Automatic Lubricating System has the oil feed under perfect control. A closed system . . . no drip, no drainage. Damage by oil—waste of oil . . . both eliminated. Each bearing is unfailingly lubricated, correctly and automatically, with the metered oil film required.

Specify all your new machines BIJUR-EQUIPPED. It pays!

BIJUR LUBRICATING CORPORATION LONG ISLAND CITY, NEW YORK

888

YOUR PLANT IS "DATED" BY THE FLOOR IT KEEPS

FLOORS
Like ILLUMINATION
had their
KEROSENE LAMP
ERA

That was before the days of Edison and the "better light—better sight movement" in industry—yet modern lighting still shows up floors that should have been scrapped or covered years ago, were not some plant owners blind to the losses and accidents old floors can cause. Some . . . but the number grows less daily!

STAMP THE DATE 1938 ON YOUR PLANT WITH

CENTRAL *Rolled Steel* FLOOR PLATES

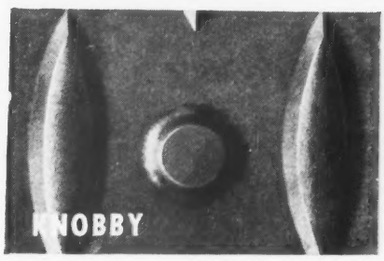
Modern Industrial Plants *are installing this* Steel Flooring . . . NOW!

If you are not yet convinced that your old floors are money wasters—why not put it up to us to "show you"? If your old floors are wearing—if they are rutted—if they are splintered or chipped or "dust"—if your men slip on them—*then you are losing money.*

If you want to save money, cover your plant floor with Central Rolled Steel Floor Plates, as so many modern plants are doing. You can do it almost overnight without interrupting production. You can get exactly the type and weight of plate suited to any location in your plant—in the machine shop, the loading platforms, storage rooms . . . on balconies, "catwalks" or step treads . . . anywhere, and you get years of trouble free, wearproof service from these plates. They cost little to install—less to maintain and to clean. They will be modern in your plant when your present equipment is obsolete.

If you are interested in the FACTS on how Central Rolled Steel Floor Plates can lower your production costs and increase production speeds—ask us to show you. Let us submit the facts, in person preferably, so we can talk it over with exact regard to *your* specific plant conditions. Write us today.

1 ALL-WAY-GRIP — General purpose flooring, maximum non-skid qualities.



2 KNOBBY — Perfect foot support, recommended for heaviest traffic.

3 KNOBBYETTE — Lighter duty flooring for general use.

CENTRAL
IRON AND STEEL CO.
HARRISBURG, PA.
Established 1853
Manufacturers of Sheared and Universal Plates—Forging Billets—Slabs
Blue Annealed Sheets—Flanged and Dished Heads—Steel Stampings—Rolled Steel Floor Plates

to do this' or 'Capital doesn't like that,' he really means that millions of people don't want their savings in something they feel is not safe or does not promise a fair return for the risk.

"Management is a smaller group of men and women. Mostly, they are people who started at the bottom of the ladder. They are usually people who have been given more important jobs because they were willing to try a little harder, to study the job, to see how they could do it better than the man or woman working alongside them. So they went up the ladder; but remember this: The higher anyone goes, the more responsibility he has to other people. He makes more money, yes, but the load he carries steadily grows.

"Take this whole group of useful people that we call 'management'—to whom are they responsible? In other words, whom must they satisfy to hold their jobs? Capital, of course—the men and women who have already invested their savings in the business and those whose savings must be attracted in the future so that the business can move forward. But capital is only a third of the story.

"In order to make a business prosper it is necessary to have a group of loyal and satisfied employees. Management can't pay wages in excess of what the business can earn and still have anything left to satisfy capital; but it still has ever before it the problem of keeping employees contented. Without this no business can succeed over the years.

"Third master that management must serve is the consuming public. There we have men and women again. Thus the whole machinery of business is working to provide the things you buy. If management can't supply the goods and services you want at the prices you can pay, management fails."

(From a radio address by W. Averill Harriman, Chairman of the Business Advisory Council and Chairman of the Board of the Union Pacific Railroad, on the Department of Commerce series "Stories of American Industry.")

•

Inland Insurance

Contributory group insurance totaling $33,759,900, covering the lives of 17,544 employees of Inland Steel Company and subsidiaries, was in effect August 31.

This is an all-time high record, both in total amount of coverage and number of employees benefitting. It is an average of more than $1,900 for each employee.

Since 1930, when group insurance was instituted at Inland, 400 claims totaling $534,575 have been paid. This is an average of $1,336.

The Inland plan covers all employees, from day laborers to executive officers. Employees earning $100 per month or less are insured for $1,000, the amount of insurance increasing with earnings to a maximum of $10,000.

with INLAND 4-WAY FLOOR PLATE

● All-steel stairways are safe against fire hazard, and the safety tread of Inland 4-Way Floor Plate also protects against falling accidents. Inland 4-Way Floor Plate can be readily cut and shaped to meet all structural requirements; also to provide a slip-proof, long-wearing re-surface over old floors where hard usage requires a heavy-duty flooring material. Leading distributors carry Inland 4-Way Floor Plate in stock. For full information write for Inland's new Floor Plate Catalog.

SHEETS • STRIP • TIN PLATE • BARS • PLATES • STRUCTURALS • PILING • RAILS AND ACCESSORIES

INLAND STEEL CO.

General Offices: 38 South Dearborn Street, Chicago, Illinois • Offices in: Detroit—Kansas City—Milwaukee—St. Louis—St. Paul

In the New Electrical Code

(*Continued from page* 96)

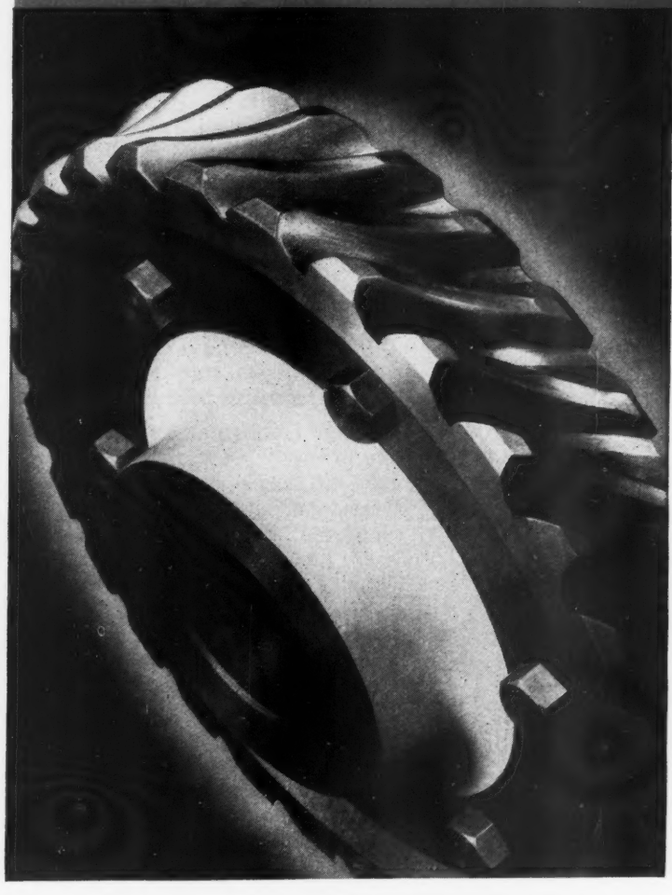
Protection of Live Parts

Section 4432—The voltage to be guarded has been dropped to 50 volts (formerly 150) and the exception for commutators and so on is now limited to those which are not conductively connected to circuits of over 150 volts to ground. Formerly this limiting voltage was 600 volts.

Article 450—Transformers

Sections 4503 and 4504—For transformers employing a liquid that will not burn, there are two more liberal provisions: (1) Special permission is no longer required for installation in a building if the transformer is provided with a pressure relief vent and with means for absorbing gases which may be generated within the case. (2) Voltage for which vault installation is re-

CORRECT IN *Every* DETAIL



PERFECTION of Cleveland Worm Gear Drives begins with the smallest details and results in remarkable lifetime performance of the complete unit.

This Company has invested more than 25 years of time, and makes large annual expenditures in engineering and other research, in order to effect bona fide mechanical improvements in details.

The precise assembly of these correctly-produced parts provides complete "Cleveland" units that possess the *stamina* you must have on every machine regardless of load—and that give *uniform performance* through long periods without need for servicing or maintenance.

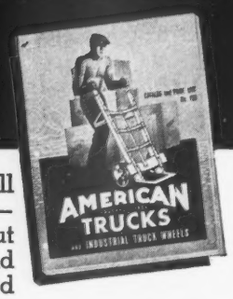
Original cost is quickly forgotten in consideration of *continuing* performance —10, 15 and even more years—and additional profits accruing from steady operation of production equipment. We will gladly send a District Representative to counsel with your own Engineers.

The Cleveland Worm & Gear Company, 3256 East 80th Street, Cleveland, Ohio.

Affiliate: The Farval Corporation, Cleveland, Manufacturers of Centralized Systems of Lubrication

★ CLEVELAND *Worm Gear Drives*

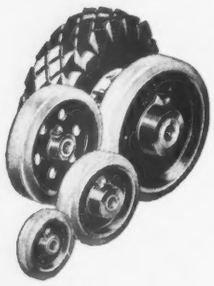
Here's a book that tells the story . . .



"American" Pressed Steel Hand Trucks roll along so smoothly—so quietly—*so easily*—that your men will get more work done without even knowing it. And you will find repair and replacement costs lower than you had believed possible.

The "American" Truk-Pak, pictured here, is a removable platform rack used with hand trucks to eliminate unnecessary rehandling. This equipment has many applications and provides unusual economies for warehouses, loading stations, transfers, etc. Ask your dealer or write direct to us for the American Pressed Steel Hand Truck Catalog illustrating trucks that answer all material handling problems.

American Tested Rubber-Tired Industrial Truck Wheels



Like American Hand Trucks, themselves, these wheels offer the rare combination of superior performance at lower cost. Savings on floors alone will pay for this quality equipment very quickly. Fragile material can be handled with less breakage and quiet operation is assured. A special vulcanizing process makes it impossible for these rubber treads to come off the wheels.

THE AMERICAN PULLEY COMPANY
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AMERICAN
PRESSED STEEL
HAND TRUCKS

quired has been raised from 7,500 to 15,000 volts.

Section 4524—Vault Doorways—A doorway on each side of a vault may be required if considered necessary by the authority having jurisdiction.

Locks are required for all doors to vaults.

Article 470—Resistors and Reactors

Section 4702—Reactors are now required to be separated from combustible surfaces, the same as resistors.

Article 620—Elevators

Section 6201—Electric wiring for dumb waiters is now covered by the provisions of this article.

Article 660—X-Ray and High-Frequency Equipment

Sections 6611, 6612 and 6613—All equipment is required to have overcurrent protection, and the low-voltage circuit must contain an automatic-opening switch.

Tables

Table 19—Flexible Cord—Several changes have been made in the recognized use for various types of cord. Some new types of cord are recognized.

When Wiring Your Plant

(*Continued from page* 86)

handbooks and standard references. The primaries of these transformers may have considerable voltage impressed on them and an accidental connection or insulation breakdown from primary to secondary would establish a high voltage on the secondary, thus endangering the lives of workmen and probably wrecking the instruments. When one side of the secondary is connected to ground any high voltage established on this winding will immediately go to ground and thus prevent danger to life, since the insulation on the secondary winding is usually not sufficient to withstand a high voltage.

The neutrals of a three-wire distribution system should likewise be grounded for the same reasons.

Similarly, the neutrals of star-connected generators, motors, and transformers should be grounded for the additional purpose of maintaining the neutral point definitely at ground potential. It is important to note, however, that when two or more star-wound machines are connected in parallel the neutral should be grounded on only one machine; otherwise, damaging circulating cur-

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PROPELLAIR FANS

THOUSANDS OF PROPELLAIR FANS ARE USED IN INDUSTRY FOR:

Cooling Men
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Cooling Products
Heat Distribution
Exhausting from Rooms
Exhausting from Machines
Exhausting Smoke
Exhausting Fumes
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. . . and for every other use where air-under-control is essential to factory efficiency.

GREATER PROPELLAIR CAPACITY REDUCES COST of VENTILATING, COOLING and EXHAUSTING!

Propellair Fans are guaranteed to move more air than other fans of equal size and horsepower. As a result, Propellairs serve more efficiently and with smaller power requirements than any other type of ventilating or exhausting fan that you can buy.

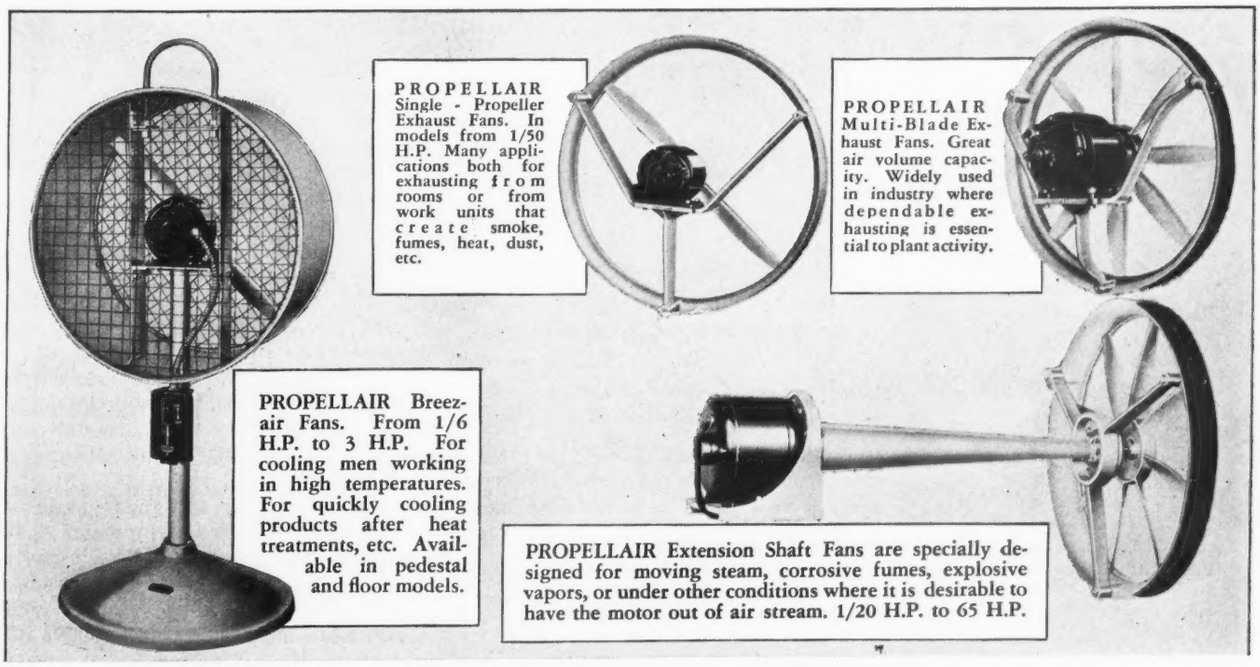
It isn't a mere happen-so that has given Propellair Fans this distinct leadership. Years of research and the application of aerodynamic principles have gone into the Propellair design. The Propellair Blade and Propellair curved entrance ring guide the air currents and by offering least resistance to their flow, work against higher static pressures than other fans of same diameter and horsepower. The exclusive Propellair tip-seal assures full efficiency across the entire blade area. Whether in duct work or working in free air, Propellair Fans move a greater volume of air with lower power requirements.

MADE TO ENDURE!

Propellairs are sturdy. Strong, light-weight, aluminum alloy construction, together with custom-built Robbins & Myers Motors, insures lifetime service under the most severe conditions.

INVESTIGATE PROPELLAIRS

Our engineers will study your needs without obligating you in any way. Whether for exhausting or ventilating—whether for large or small installations—it will pay you to write for a Propellair quotation today.



PROPELLAIR Single - Propeller Exhaust Fans. In models from 1/50 H.P. Many applications both for exhausting from rooms or from work units that create smoke, fumes, heat, dust, etc.

PROPELLAIR Multi-Blade Exhaust Fans. Great air volume capacity. Widely used in industry where dependable exhausting is essential to plant activity.

PROPELLAIR Breezair Fans. From 1/6 H.P. to 3 H.P. For cooling men working in high temperatures. For quickly cooling products after heat treatments, etc. Available in pedestal and floor models.

PROPELLAIR Extension Shaft Fans are specially designed for moving steam, corrosive fumes, explosive vapors, or under other conditions where it is desirable to have the motor out of air stream. 1/20 H.P. to 65 H.P.

Also a full line of 4, 6 and 8 bladed Propellair Fans for use in exhaust systems involving duct work or high velocities.

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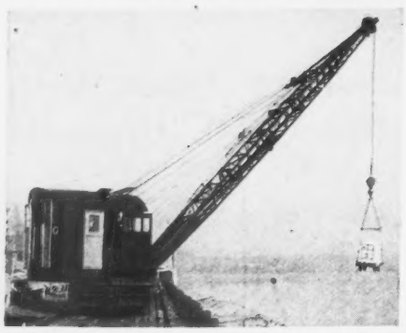

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N1—35 to 50 Ton

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CENTRAL AND PORTABLE VACUUM CLEANING SYSTEMS

123-C

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rents may flow within the machines.

It is known that a considerable proportion of electrical outages and accidents is brought about by inadequate ground connections. Remember that it is not at all sufficient to drive a ground rod or make a connection to a water pipe in any old way. Ground current may occasionally be of high magnitude, and study is required to determine the maximum number of amperes a ground connection may have to carry. Connections should then be made sufficiently heavy to carry such currents.

To Pipes or Plates

A common method is to ground to a water pipe. In such cases care must be taken to make sure that there will never be an interruption in the pipe itself, and that all the joints are electrically conducting. Sometimes it is necessary to provide copper jumpers across some of the joints, and across the water meter. Pipes or ground rods driven into the ground represent other methods.

Frequently copper plates are installed in rivers, ponds, and permanently moist soil. If the soil tends to dry out, placing charcoal above and below the plate will help to keep the resistance low. Resistivity of the soil can be reduced by dissolving in the moisture normally contained in it, such materials as copper sulphate, common salt, or calcium chloride.

Connections to ground plates should be heavy, solid copper to a point above the ground, so that they will not corrode easily. They should be welded or brazed to the plates.

Copper Rods Last Longer

The most common driven grounds are: galvanized steel pipe, used because it is cheap and handy, but it is not necessarily good because it may corrode rapidly; solid copper in a star-shaped section; round copper-clad steel; and round galvanized steel.

Preferably, ground rods should be chosen to fit the soil in which they are to serve, in order to keep corrosion to a minimum. Few materials are best for all soils. Copper rods are standard. Solid copper offers the longest life against corrosive action. Copper-clad rods are subject to more rapid disintegration after the coating has become pitted through.

The accompanying charts taken from Bureau of Standards publications, show some of the characteristics of ground rods and soils.

It cannot be over-emphasized that

300 Times an Hour

OPEN, shut—open, shut. Ceaselessly, valves are opened and shut in a special "torture machine" at the Crane laboratories. Five times a minute . . . 300 times an hour . . . 2,400 times every eight-hour shift, until the stem gives up its life and the "post-mortem" adds to the vast body of Crane knowledge of valves.

Engineers tabulate the results and study the thread profiles and thread clearances of the valves when finally they are worn out. From this comes definite information showing how to make good valves better . . . and better valves the best for their type of service.

Crane has tested to destruction thousands of valves, seeking information with which to build still better valves. Crane meets the challenge of "new" valve problems with solutions based on 82 years of valve and piping experience. Look in your new Crane No. 52 Catalog for the details regarding 38,000 items, tested in the laboratory and proved on the job. Use it whenever you need valves, fittings, pipe or accessories. CranEquip for satisfaction.

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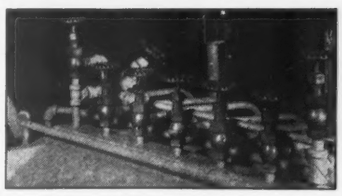
STICKING TO QUALITY SIMPLE SAFEGUARD, SAYS ENGINEER



NEW YORK CITY, Nov. 17—"The power plant engineer who sticks to a policy of buying only quality products, whether large or small items, is the man who operates at lowest costs and with least trouble," said a power plant engineer here today.

"The original cost of a small valve is so little, or the leakage from one small valve may seem so small that it is easy to overlook the large losses over a year that come from replacing many small valves or having a large number of small leaks," he continued.

Crane has always recognized the importance of doing small things well. The testing of small valves to destruction in a machine that opens and shuts them continuously under service loads is one illustration of Crane care in providing highest quality at low cost in small valves.

The results of these tests are reflected in better threads, better stems, better body and seat materials. When next you need small valves, specify Crane. Check up, for example, on the number of spots where the Crane No. 7 line of valves can serve you. Sizes from ⅛ to 3 inches, globe and angle, screwed or flanged, Slip-On Disc Holder for quick and easy replacement, discs of various types for various services. See page 16 of your Crane No. 52 Catalog for details. CranEquip for piping satisfaction.

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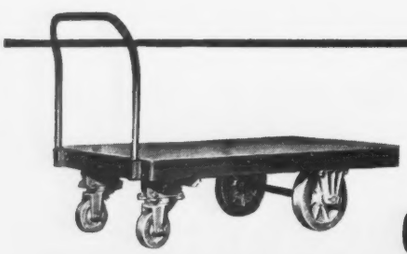

Service
CASTERS & TRUCKS

there is never such a thing as too good a ground. The better the ground connection the lower its resistance, and therefore the better and safer the installation.

Frequently the question is asked: Should lightning arrester grounds be connected to the regular grounding system, or should they be separate? Many follow the practice of connecting all grounds together. However, the subject is controversial. From the standpoint of the arrester it is better to connect all grounds together. So far as safety to operators and equipment is concerned, it is open to question.

All grounds should be inspected and tested regularly, and maintained in good condition. This is a most important point, but it is frequently overlooked. It is a matter of experience that soil conditions may change to such an extent that a ground connection showing a resistance of 1 ohm today may show as much as 100 or 200 ohms a month from now. Connections may be broken in various ways, or be burned out by discharges.

How Cables Are Grounded

Meters for testing all grounds quickly and easily can now be had at reasonable cost. Any establishment that has a considerable investment in electrical machinery and wiring should have such a meter. The maintenance force should have strict instructions to test all grounds at regular intervals, and repair any defects at once.

With cable installations it is uniform practice to ground lead sheaths and metallic armor for protection against electrolysis, heavy fault currents, or excess sheath voltages. Exceptions must be made in some cases, such as the sheath or armor of single-conductor cables, where a variety of grounding systems is available. Large-size, single-conductor, leaded cable when installed in dry locations, insulated from ground, or equipped with insulating sleeves, or when all of these conditions are present, often is grounded only once, to reduce or eliminate circulating current losses. Competent engineering advice is needed in such cases in order to make sure that the correct procedure is followed.

Junction boxes, potheads, and joint sleeves are grounded when connected to metallic-sheathed cable. If not, they should, with a few exceptions, be grounded separately.

It is particularly important and necessary to ground thoroughly the shielding tape on shielded-type ca-

11 YEARS....AND NO BEARING FAILURES

That's What ALEMITE Guns, Fittings, Lubricants Have Meant to R. Wallace & Sons

• There's half a ton of molten tin in this machine, heated to 500° F. — radiating this terrific heat to the bronze sleeve bearings directly above! There are ten of these machines, yet *not a single bearing* has failed in the last eleven years — thanks to the *Alemite* Guns, Fittings, and Lubricants used in taking care of them!

Small wonder that R. Wallace & Sons — famous silversmiths and world's largest manufacturers of table tinware — are enthusiastic in their praise of Alemite Lubrication! With the Alemite Hydraulic System, lubricant is *forced* into every bearing to provide positive, metered lubrication. The Alemite Guns can't slip off Alemite Fittings to cause accidents. Lubricant is kept off machines and belts because there is a leakproof seal between gun and fitting, even when the gun is applied from an angle.

WRITE TO US ABOUT YOUR PROBLEMS

No matter what you manufacture, Alemite Controlled Lubrication can help you avoid bearing failures, cut lubrication costs, prevent deterioration of equipment, reduce power consumption! No other system can give you the *exclusive advantages* of Alemite Hydraulic Guns and Fittings. Write to us about your own lubrication problems. The experience of Alemite Industrial Lubrication Engineers is at your service, without obligation.

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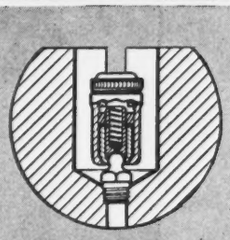
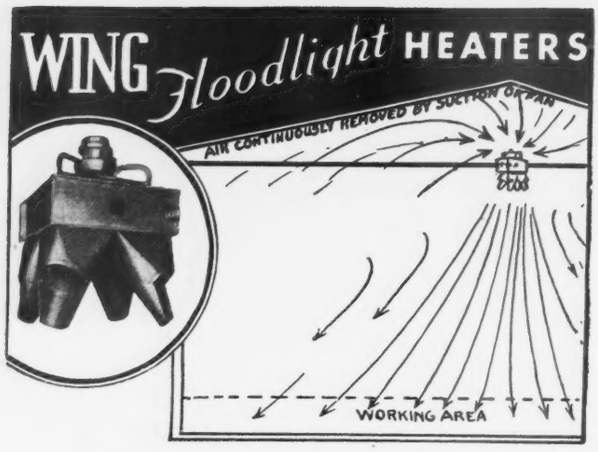


SEE HOW TIGHTLY THE ALEMITE HYDRAULIC GUN GRIPS THE FITTING

There's no other lubrication fitting like the Alemite Hydraulic Fitting. It's cyanide-hardened to stand up under severest punishment. It's made with a wide mouth to permit free flow of lubricant under pressure. When the Alemite Hydraulic Gun engages the Alemite Hydraulic Fitting no lubricant can leak out to cause deterioration of belts. Adequate pressure is easily developed, and the greater the pressure the tighter the seal!



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They stop heat accumulation at the roof where it's wasted — but project warmth evenly to every point in the working area.

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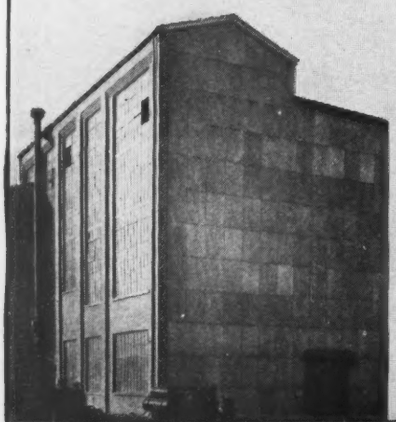

Once and for all—end painting and other upkeep with this fireproof, rot-proof and wear-proof material. Formed of asbestos and cement, under tremendous pressure, Careystone is meeting the demands of industry for a product low in first cost, permanent and that eliminates maintenance expense. Careystone is impervious to moisture, rust, acids, alkali and salt air. The color is a pleasing, natural, cement gray. Made in standard sheets 42 inches wide and up to 10 feet in length, Careystone Roofing and Siding is quickly and inexpensively applied. Write today for booklet giving full details.

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bles. Such grounding protects the insulation from surges and allows it to perform in the way for which it was designed.

Detailed instructions for grounding will be found in the 1937 National Electrical Code, which is now available. All types of equipment are covered. These instructions apply to all cases where the Code has jurisdiction and in general represent good practice, but it must be remembered that the Code specifications are prescribed minimum conditions that are not necessarily always adequate for first-class industrial installations. In complicated cases, such as arise in power station or industrial control wiring and installation, additional instructions may be necessary. They may be determined by experience or be based on the advice of the manufacturers of the equipment involved.

In concluding this series of articles I wish to emphasize the fact that they were not intended to serve as a text- or handbook. Every point discussed could have been treated at greater length. Many subjects could not be touched upon at all. Hence, the purpose was merely to point out to busy plant men the most important features of wiring installations and indicate what precautions must be taken in order to secure the quality of electrical service needed.

Grateful acknowledgment is made to Mr. M. M. Samuels for his assistance in the preparation of the material presented.

Same Power, New Drives, Doubled Output

(*Continued from page* 94)

thus making it unnecessary to keyseat shafts.

A further adaptation of the drive to the mill's peculiar conditions is seen on the second floor, in the carding room. Experience has shown that here the usual low-water conditions supply enough power to drive the old machines. There are, however, three groups of new machines of extra-large size which require more power than is available when water is low in the river. These machines are so located that disconnecting the pulley from the lineshaft at each of three points is sufficient to cut them off the line.

Mounted close to the ceiling and protected to reduce dust exposure are three electric motors. Opposite each motor is space for a pulley so

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FOR MODERN APPLIANCES, MACHINES, AND EQUIPMENT

In plants of all sizes—in practically every industry—management is finding it profitable to install modern appliances and machines equipped with modern Wagner motors.... The motors that have all the requisites of well-balanced design... the motors that embody characteristics and features to give them long-life, dependability and added protection against failures... the motors that are the products of years of continuous improvement... the motors that are diversified to meet the design requirements of modern appliances and machines. The illustrations show a few typical Wagner motors modernized to anticipate your motor needs of today. Send today for literature describing these modern Wagner motors.

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14,500 FEET OF WELDING ON 36 FANS — One certain process in a large chemical plant demands conditioned air almost microscopically clean. Clarage furnished the fans for this exacting job — 36 of them built of Monel metal to prevent corrosion. Photo above shows a Clarage skilled worker completing one of the fan housings. Our 25 years' experience counts!

WHEN you have any type of "air problem", remember the name CLARAGE. This name ranks high in the air handling and conditioning field.

We manufacture fans, blowers, mechanical draft apparatus, unit heaters, coolers and conditioning equipment for every need — products seasoned by over a quarter - century of experience.

Your requirements entrusted to us are in EXPERT hands — and that always means RESULTS with UTMOST ECONOMY.

NEW HIGH-SPEED, HIGH-EFFICIENCY DESIGN — Even on the simplest exhaust fan application, it pays to consult Clarage. The use of our new Type W Fan can make possible as high as a 25% reduction in size of motor required for drive — and invariably operating costs (power consumption) are below normal expectations.

CLARAGE FAN COMPANY

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located on the drive for the group of big machines that it can be coupled on merely by putting a belt on the motor pulley and on the group drive pulley. The millwright keeps these three pulleys downstairs in the dyehouse, where the moist atmosphere prevents the leather from drying out. If the river gets too low to drive the machines at proper speed, it is not more than a 15- or 20-minute job to shift the big machines over to electric drive. Similarly, it takes no longer to put them all back on the main lineshaft when river conditions get better.

More Room in the Aisle

This change to electric drive is economically possible because a substantial portion of the first floor operates on central station electric power, with individual motor drives, at all times. This represents a plant addition of a good many years ago.

General revamping of power transmission was not overlooked even in these departments. For example, brushing machines on the first floor were formerly driven by flat motor belts. The difficulty was that there was not an adequate, safe walkway between this end of the machines and the outside wall of the building. The flat belts were supplanted with V-belt drives, with a considerable saving in space, since the V-pulleys were placed on the old shafts, and the motors moved over close enough to the machines to leave an adequate walkway. Now one can work along this aisle just as freely as in any other aisle in the plant.

Doubled Power in 30 Days

The speed with which the new transmission equipment was installed is typical of the time-saving improvements developed in recent years. The entire job had to be completed in a little more than 30 days in order to get the mill into production for the fall rush on automobile models. Planning started during the last week in July, and the mill was running from its new power transmission equipment on the first of September.

Installation was handled by the equipment manufacturer's own millwright, loaned for the emergency. To save time and the expense of keyseating, split pulleys with interchangeable bushings were used, thus enabling the millwright to put the shafting in place, and then locate the pulleys at the spots required as they were shipped to Janesville.

Advantages to Rock River Woolen

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Round—Flat—Half Round Straightened and Cut Shape Wire

HIGH CARBON SPRING
OIL TEMPERED — LOW CARBON
BASIC OR BESSEMER
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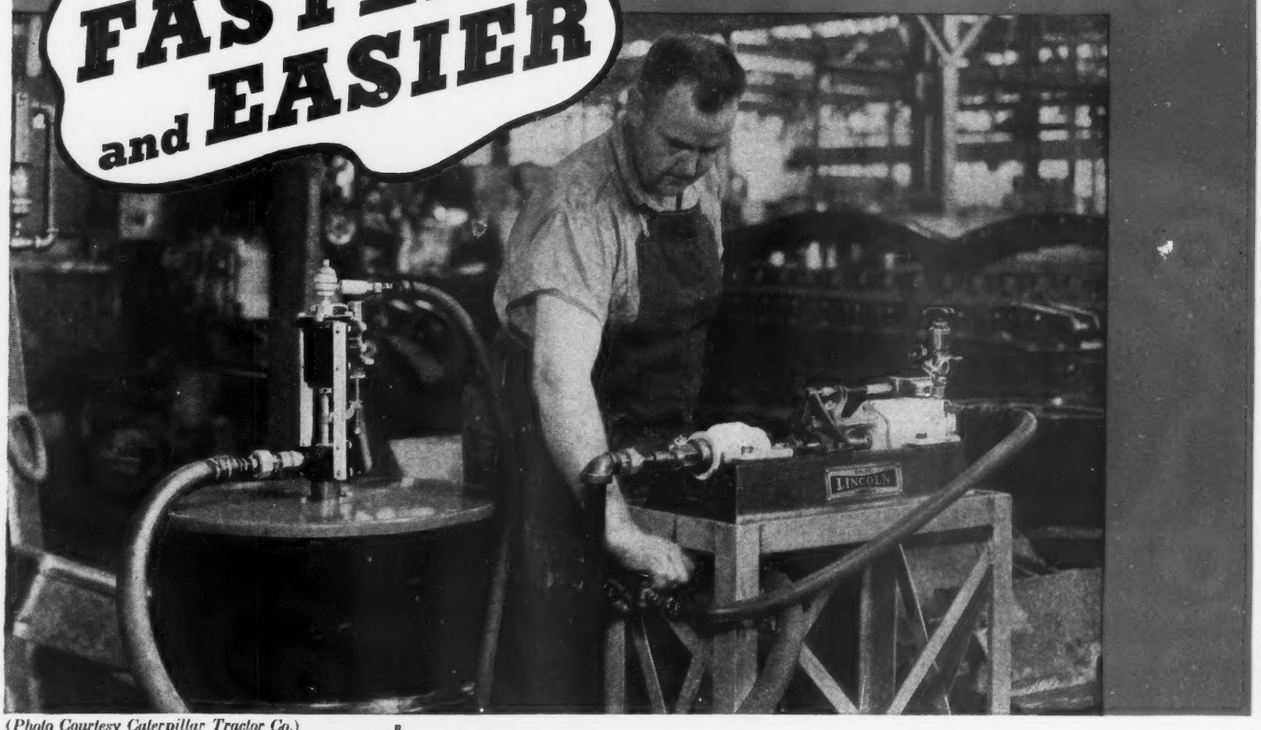
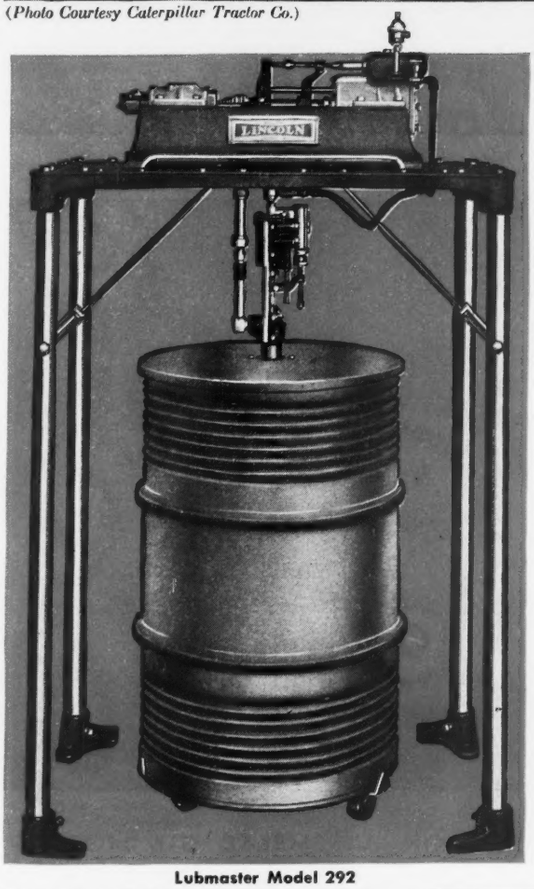
FASTER and EASIER

If you make a product that requires grease lubrication during assembly—it will pay you to follow the example set by the manufacturer whose Lincoln installation is shown below.



(Photo Courtesy Caterpillar Tractor Co.)



Lubmaster Model 292

LINCOLN
LUBRICATING EQUIPMENT

is ideal for pumping grease from the original drum into units as they pass along assembly line

It doesn't make any difference whether your product is large or small, if you make an item that needs to be greased, you can lubricate it faster and easier with Lincoln Lubricating Equipment.

The complete industrial line manufactured by Lincoln includes lubricant dispensing equipment ranging from small hand guns to heavy-duty power operated equipment such as Model 292.

The Lubmaster, shown at left, dispenses lubricant direct from an original 400-lb. drum, and is designed for service where maximum volume at high pressure is desired.

Other items in the Lincoln line include KLEENSEAL and Button Head Fittings in all types and sizes to meet modernization and replacement needs.

Obtain complete information through your nearest Lincoln jobber, or write us for a copy of Catalog No. 60.

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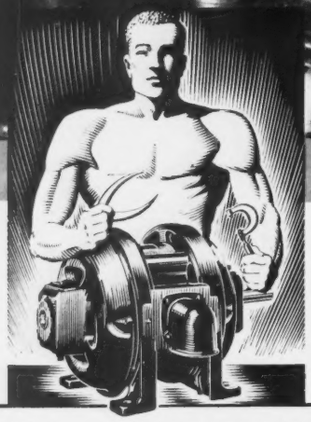
CHECKING IN ADVANCE



G-E MOTORS PASS ALL TESTS

Right—To check the proper operation of the oil rings in a G-E sleeve-bearing motor, this inspector has simply to lift the convenient spring-return oil-well cover to see clearly inside the housing. The cover always snaps back into place, forming a protective seal against dust, dirt, etc. It cannot be lost, nor are there any screws or plugs to remove. This is another of the convenience features of G-E motors

RUNNING TESTS ON ASSEMBLED G-E MOTORS GIVE FINAL ASSURANCE OF DEPENDABILITY

020-329

GENERAL ELECTRIC

ON MOTOR PERFORMANCE

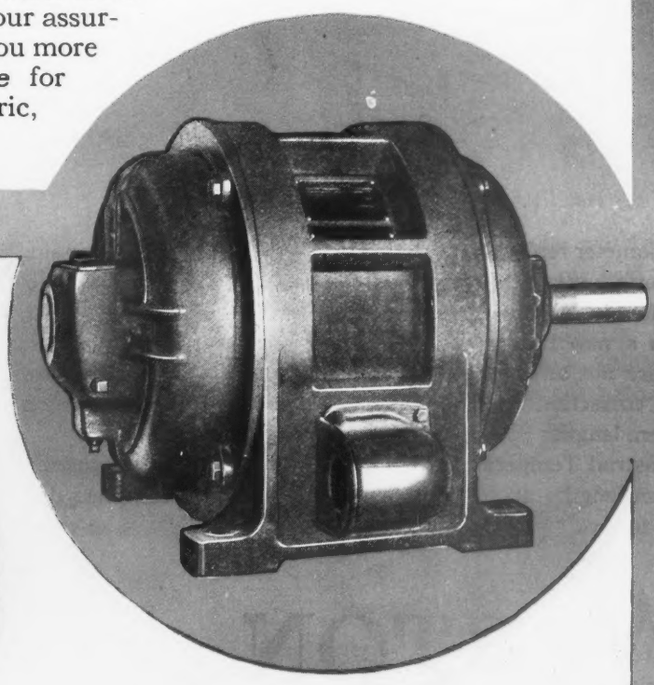
UNDER the keen eye of this inspector must pass every sleeve bearing of a certain size that is to go into G-E motors. He checks every essential dimension, some of which must be accurate to five ten-thousandths of an inch.

He carefully inspects the hard-tin-babbitt lining for concentricity and smoothness. No smallest burr is left that could hinder effective lubrication or injure the bearing surface in operation. Only those bearings that meet these rigid requirements are allowed to pass.

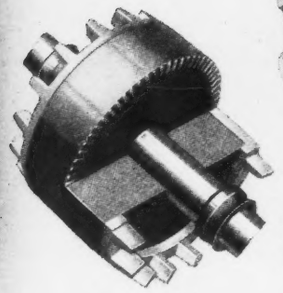
After each motor has been assembled, it is run to check the smooth, cool operation of the bearings. The oil rings must function properly—unless each one is turning freely, carrying an ample supply of oil to the shaft and lining, the motor is rejected.

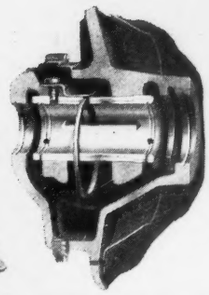
Notice, at the lower left, how easily this check can be made by means of the spring flap on the oil-well cover. This dust-tight spring flap will provide a quick, easy means of checking proper bearing operation of these motors in your own plant.

Trained inspectors are stationed at key points throughout G-E motor factories to make sure that all parts for G-E motors comply with General Electric standards. The tests they make are a check in advance on the kind of performance you want from the motors you buy. They are your assurance that G-E motors will give you more value *in actual performance* for your motor dollar. General Electric, Schenectady, New York.



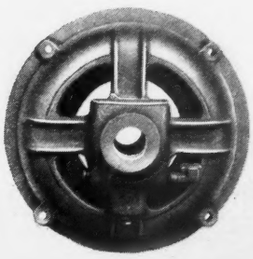
YOU GET THESE EXTRA-VALUE FEATURES IN G-E SKELETON-FRAME INDUCTION MOTORS (15 TO 75 HP)



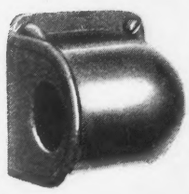


Steel-shell, babbitt-lined sleeve bearings, sealed against dust and dirt, assure long life of bearings and low maintenance costs

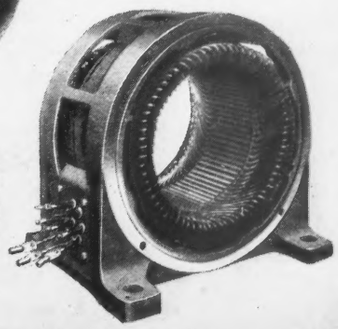
Indestructible cast-aluminum rotor windings, with integrally cast fans, have no joints to cause high-resistance spots



Strong, cast-iron end shields protect the end windings, permit the entrance of ample cooling air, and assure rigid support for the bearings

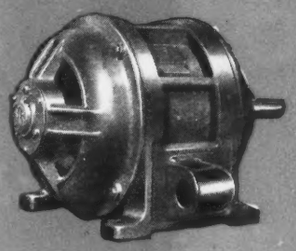


You save time and trouble in making connections in these roomy conduit boxes. Can be mounted in any one of four positions. Leads have pressed-on, no-solder terminals

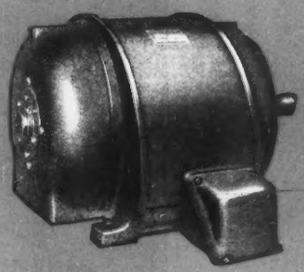


This cast-iron skeleton frame is unusually strong and rigid. High-quality insulation of these form-wound coils used in the larger sizes means long motor life and low upkeep costs

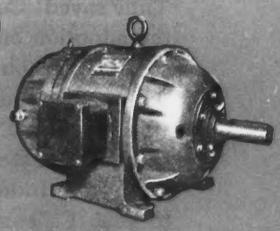
A G-E MOTOR FOR ANY CLASS OF SERVICE



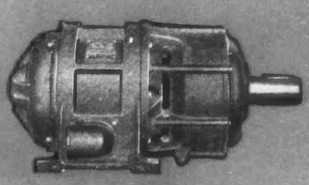
G-E ball-bearing motors—which have cartridge-type bearings—can be disassembled without exposing the bearings. Pressure-relief greasing permits lubrication without shutdown



On jobs where there are splashing or dripping liquids or falling particles, use G-E splashproof motors—they will give you longer motor life and lower operating costs



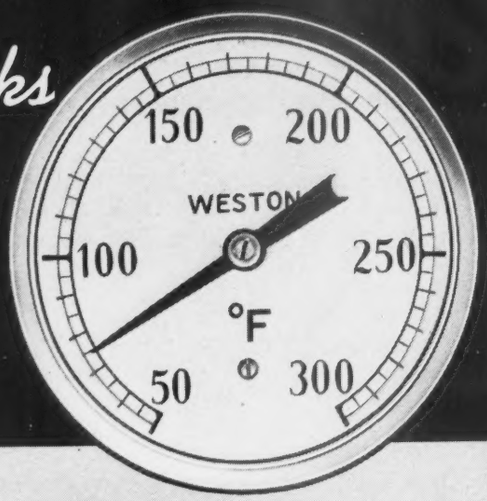
G-E totally enclosed, fan-cooled motors will quickly pay for themselves in lower upkeep on dusty, dirty jobs or in extremely moist, acid, or corrosive atmospheres



Where you need a compact, efficient, low-speed power unit, use a G-E gear-motor—it will help you reduce your power-equipment investment and power costs

A THERMOMETER

that checks on all points!



PRACTICALLY INDESTRUCTIBLE
(all metal)

PERMANENCY OF CALIBRATION
(no gas, no fluids)

SUSTAINED ACCURACY
(accuracy 1% over entire scale)

READABLE
(gauge type dial)

RAPID RESPONSE

EASY TO INSTALL

Sectional view showing operating parts of WESTON *Industrial Temperature Gauge.*

Frequent thermometer replacements avoided! Errors in reading eliminated! Time saved! Costs lowered! . . . these are some of the results which follow the adoption of WESTON Industrial Temperature Gauges.

Operating on a new but thoroughly proved *all-metal* principle, these thermometers are not affected by severe vibration or over-temperatures, and require no correction (such as capillary or heat transfer correction) regardless of stem length.

WESTON Industrial Temperature Gauges now are available in ranges up to 1000°F., stem lengths up to 24 inches. You will want complete data. Return coupon today.

WESTON
Temperature Gauges

Weston Electrical Instrument Corporation
628 Frelinghuysen Avenue, Newark, N. J.
Send complete information on WESTON Temperature Gauges.

Name.....

Address.....

City..... *State*.....

Mills have come in a good many assorted ways in addition to the increase in useful power delivered to the machines. This increase is estimated at close to 100 per cent, which means a substantial saving in the cost of electric power, although everything has to be estimated, rather than measured, since the changes in power transmission came at the same time as the increase in machine capacity, these changes altering two sets of factors and making impossible an absolute allocation of savings.

No Time Out for Breakdowns

The auxiliary savings come both in production and maintenance. With the new equipment, there simply is no such thing as a transmission breakdown; hence machines can keep on producing instead of standing idle for shaft, belt, or pulley repairs. The maintenance saving comes from the same direction: obviously, there is a reduction in maintenance cost when breakdowns are less frequent. The millwright has been able practically to divert his men from all power transmission repairs, devoting only a small amount of time to periodic inspections and regular maintenance rounds.

One large saving is in lubrication time. Formerly the bearings needed lubrication several times a month; the present bearings need be lubricated only at six-month intervals. The millwright has been able to catch up with a world of small and less pressing repairs which had previously been let slide while the men worked on, say, a twisted-off coupling.

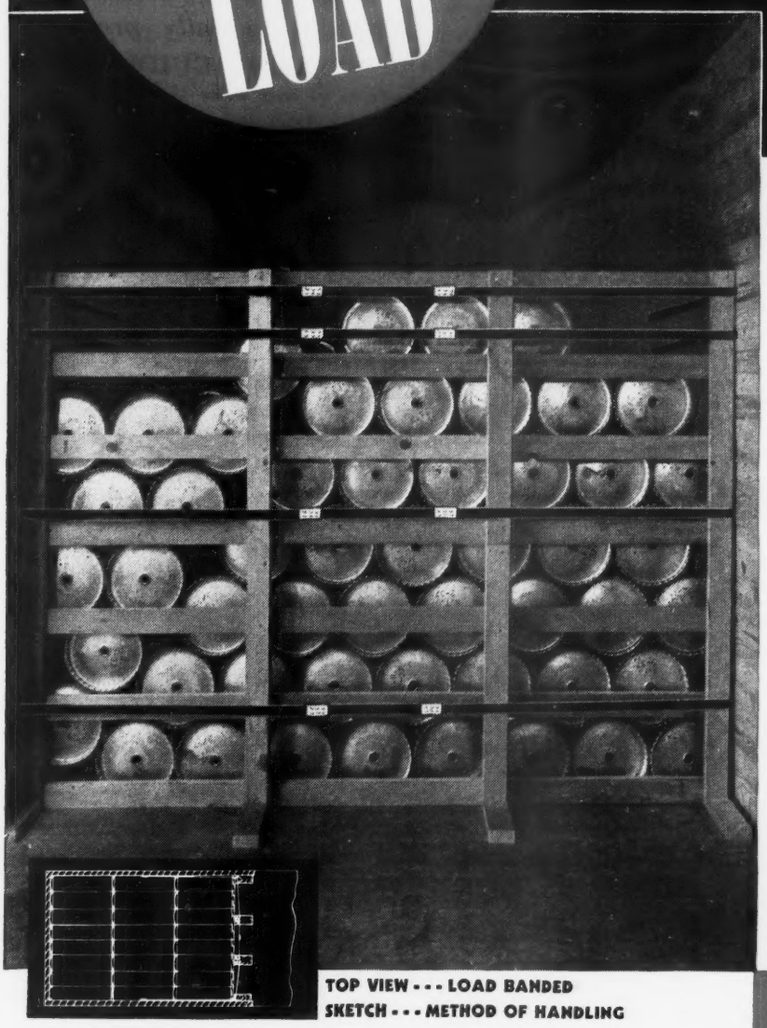
Belt lacing and adjustments are lower than ever before in the mill's history. Standardization on modern equipment and the fact that the modern shafts and pulleys run true without weave, has reduced belt stretch and other belt troubles. Vibration in the buildings is noticeably lessened, which will mean savings in building maintenance over the years, even though they cannot be detected at first.

But with all of these advantages, it is essential not to overlook the basic reason why the power transmission equipment was revamped. It was necessary to increase productive capacity and put the mill on a mass-production basis. This has been accomplished on approximately the same volume of water power as before, and without the otherwise unavoidable investment either in additional waterwheel capacity or additional electric motors.

BETTER LOAD

FOR MANUFACTURER OF HOT WATER TANKS

With the Stanley Car Banding System this manufacturer ships hot water tanks BETTER PROTECTED and CHEAPER than ever before.

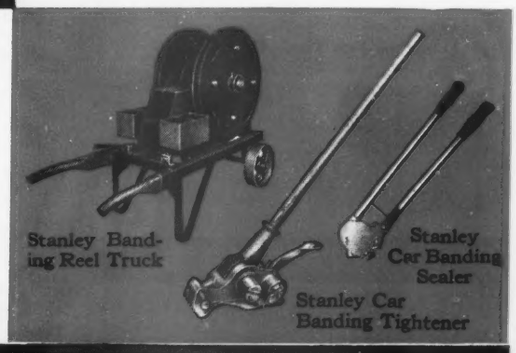


TOP VIEW - - - LOAD BANDED
SKETCH - - - METHOD OF HANDLING

Car bands are fastened to freight car walls with anchor plates. A bulkhead of two-by-fours is placed against car-end of tanks. The bands are tensioned across the bulkhead and foot blocks are nailed to the floor. Result: a firmly braced load; every tank locked in position; no chance of dents or sprung seams; tension of steel bands absorbs car impacts, prevents bulkhead from loosening or giving way.

Shippers of all types of merchandise, from aircraft motors to beer bottles get better loads at lower cost. (1) ***By preventing damage.*** Superior protection compared to wood bracing — a fact verified by the Freight and Claims Division of the American Association of Railroads. (2) ***By speeding shipments.*** Bracing that required from one to 3 or 4 hours, now takes an average of 30 minutes. (3) ***By saving on lumber.*** Wood for bracing that cost from $2.50 to $40 is replaced by material costing from $2 to $3. (4) ***By saving on labor.*** Simplified Stanley Banding takes a minimum of time. (5) ***By saving on freight.*** Dunnage, per car, is oftentimes reduced as much as 1400 pounds.

Stanley engineers will help you find the most profitable method of car banding. Stanley will supply you with everything you need in materials and tools — all shown in the new Stanley Car Banding Catalog. Contains actual case histories! Write for it to-day.



THE STANLEY WORKS
STEEL STRAPPING DIVISION
159 LAKE STREET, NEW BRITAIN, CONN.

STANLEY

STANLEY CAR BANDING SYSTEM

ONE-HAND OPERATION

makes this New TIME CLOCK 32% FASTER

The New Stromberg UNI-SPEED

●This amazing new Time Clock has two "speed" features that save many minutes for both employer and employees. First, it is one-hand operated, insuring a fast-moving line when employees are punching "in or out," and second, time card registrations are printed on the front of the card, making them easily and quickly read.

This new automatic Time Clock meets the requirements of any business, regardless of working hour schedules. It prints "late arrival" and "early departure" registrations in red, if desired, and in many ways cuts much of the timekeeper's routine work in half.

Ask about liberal trade-in allowance on your old Time Clock. Write today.

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Stromberg Time Recorder Co. of Canada, Ltd.
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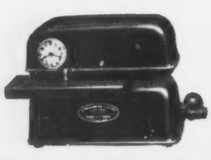
SALES AND SERVICE OFFICES IN ALL PRINCIPAL CITIES

Manufacturers of In-and-Out Recorders, Time Stamps, Job Time Recorders, Commercial and Advertising Clocks, Program Instruments, and other Time Equipment

Electric Job Time Recorders



Cost records, to be worth anything, must be accurate. Stromberg Job Recorders provide an accurate yardstick on the efficiency of workers. They *cut down wasted time.* Electrically operated, foolproof, inexpensive to maintain—they belong in your cost system.

MAIL THIS COUPON TODAY!

(Paste on postcard if you desire)

STROMBERG ELECTRIC COMPANY
231 West Erie Street, Chicago, Illinois

Please send me illustrated booklet containing complete information on: (Check) The New Stromberg Uni-Speed Recorder ( ); Job Recorders ( ); Time Stamps ( ).

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TRADE LITERATURE

Air Filter—Bulletin No. 500-3, on "Norblo" square-type air filter.—The Northern Blower Co., 6409 Barberton Ave., Cleveland.

Air Filters—Bulletin D-108, on "Double-Duty" Model L air filters—Independent Air Filter Co., Inc., 228 North La Salle St., Chicago.

Belting—Folder, on Tannate leather belting.—J. E. Rhoads and Sons, 35 North Sixth St., Philadelphia.

Boiler Units—Bulletin 260-B14B, on automatic boiler service units.—Roots-Connersville Blower Corp., Connersville, Ind.

Capacitors—Booklet, showing construction and use of Pyranol capacitors.—General Electric Co., Schenectady, N. Y.

Conveyor Chain—Folder No. 1651, on No. 4250 Swivel Chain for conveyors.—Link-Belt Co., 220 South Belmont Ave., Indianapolis.

Conveyors—Folder, showing roller gravity conveyors.—Samuel Olson Mfg. Co., Inc., 2418 Bloomingdale Ave., Chicago.

Conveyors—Catalog No. 47, showing a complete line of belt conveyors and bucket elevators for handling bulk materials.—Stephens-Adamson Co., Aurora, Ill.

Cutting Tools—Booklet, lists 18 books and folders published by the company on hard-facing alloys and cutting tools.—Haynes Stellite Co., Kokomo, Ind.

Diesel Power—Folder, showing uses for diesel power.—Caterpillar Tractor Co., Peoria, Ill.

Electrical Products—Catalog No. 60 and 60-S, describing line of switches, channels, fuse boxes, fittings, etc.—Colt's Patent Fire Arms Mfg. Co., Electrical Division, Hartford, Conn.

Electric Tools—Catalog No. 38, on line of portable electric tools.—Skilsaw, Inc., 3310-20 Elston Ave., Chicago.

Electrodes—Booklet, on stainless steel electrodes.—Page Steel and Wire Division, American Chain & Cable Co., Inc., Bridgeport, Conn.

Geared Motor Reducer—Folder, on the Motodrive, a combined motor and variable-speed transmission.—Reeves Pulley Co., Columbus, Ind.

Hacksaw Blades—Booklet, showing use of hacksaws and data on blades.—W. O. Barnes Co., Inc., Detroit.

Heating Specialties—Bulletin V260, a catalog of steam heating specialties.—The Trane Co., La Crosse, Wis.

Instruments—Bulletin K, a condensed catalog showing line of air conditioning products.—Julien P. Friez & Sons, Inc., Baltimore.

Instruments—Folder, describes significance of the company's seal of certification on its instruments.—The Foxboro Co., Foxboro, Mass.

Instruments—Three Bulletins: 1535 on improved ohm scales for insulation testers; 1540 on direct-reading ohmmeters; 1545 on Midget "megger" tester for insulation resistance.—James G. Biddle Co., 1211-13 Arch St., Philadelphia.

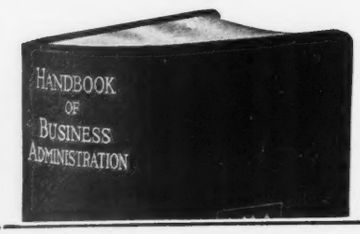
Insulating Material—Catalog, describing Micabond, a bonded mica insulating material.—Continental-Diamond Fibre Co., Newark, Del.

Insulating Products—Form GI-6A, catalog of insulating products such as roofing, flooring, conduits, packings.—Johns-Manville, 22 East 40th St., New York.

Insulation—Form IN-55A, a catalog on sheet, block, and pipe insulations for heated and refrigerated equipment.—Johns Manville, 22 East 40th St., New York.

Lamps—Bulletin 1530, on Pointolite lamps.—James G. Biddle Co., 1211-13 Arch St., Philadelphia.

Lighting—Folder describing two lighting fixtures.—Duquesne Light Co. 435 Sixth Ave., Pittsburgh.



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● In the average plant, *loads must move forward 7 times* in process to shipment.

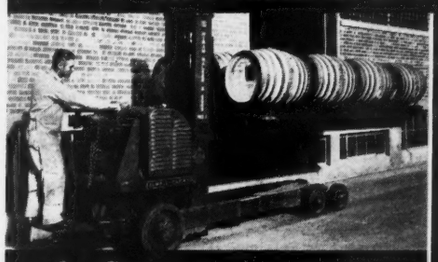
Out of its 30-year background of experience building Power Industrial Trucks *exclusively,* Elwell-Parker has analyzed these 7 progressive motions and has *proved* that loads can be transported at large savings by Elwell-Parker Trucks at *all* of them—not merely a few.

Elwell-Parker has engineered, designed and built Trucks for each separate step in the series. Only a few can be shown here—but enough to demonstrate the depth of Elwell-Parker's constructive thinking, and the economies realized from Elwell-Parker *Systems* of Load Transportation in actual service—saving their cost over and over.

Call an Elwell-Parker Engineer to join you in a bird's-eye look at your own plant, with the view of uniting *all* your movements of material into one profit-earning flow. The Elwell-Parker Electric Company, 4323 St. Clair Avenue, Cleveland, Ohio.

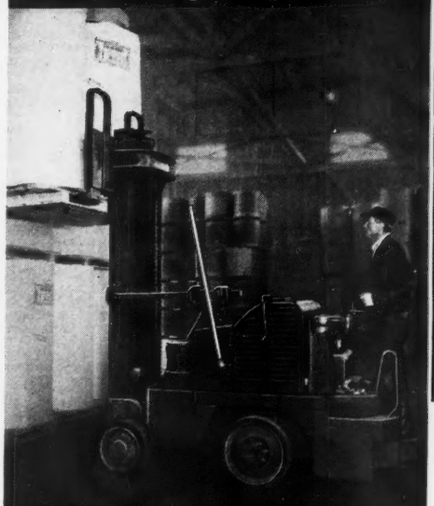
1—Raw material arrives at receiving dock

2—To raw storage



3—Storage to process

4—Through process



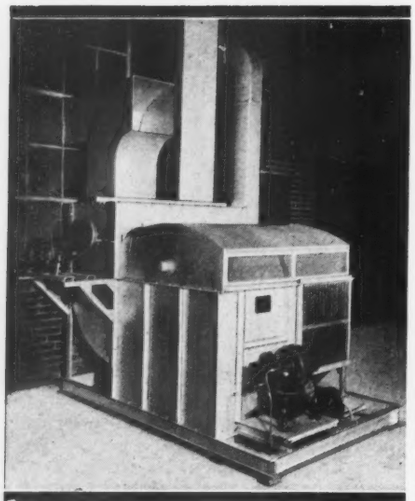
5—Process to warehouse

6—To packing

7—To shipping

New Type **ELWELL·PARKER** *Trucks*

ESTABLISHED 1893 • BUILDING POWER INDUSTRIAL TRUCKS SINCE 1906



Smith Automatic Oil Fired Unit Air Heater

SOLVED!

Problem of Adopting Fuel Oil to Direct Fired Factory Heaters Has Been Solved as Result of Three Years in Smith Testing Laboratories.

The Smith Automatic Unit Oil Fired Air Heater is the answer. "Spot it" on the floor or overhead. Pay for heat only when needed. Set your thermostat, push a button and "forget it" till spring. No boiler room, steam lines or costly overhead. Up to 1,500,000 b.t.u.'s per hour, yet up to only 6 ft. 6 in. in height. Here's a trim, compact, business-like heating machine, the finished result of over 15 years' acquaintance with industrial conditions. An accurate analysis of your situation will cost you nothing.

The Smith Unit Automatic Air Heater also burns gas or coal.

JAMES CAMPBELL SMITH
INCORPORATED
1675 Collamer Road Cleveland, O.

Lighting Equipment—Catalog No 50 Series B, showing full line of lighting equipment.—Wheeler Reflector Co., 275 Congress St., Boston.

Machine Tools—Catalog, title "What Makes Main Street?" showing line of machine tools.—The R. K. LeBlond Machine Tool Co., Cincinnati.

Motors—Two bulletins: 122, on splash-proof Tvpe AA motors; 124, on explosion-proof Type AA motors.—Reliance Electric & Engineering Co., Ivanhoe Rd., Cleveland.

Pumps—Bulletin 6640, on ejector centrifugal pumps.—Fairbanks, Morse & Co., 900 South Wabash Ave., Chicago.

Pyrometer-Controller—Bulletin No. 3197, describing "Alnor" electronic pyrometer-controller.—Illinois Testing Laboratories, Inc., 420 North La Salle St., Chicago.

Refractory Brick—Leaflet, on Insulbrix fire brick.—Quigley Co., Inc., 56 West 45th St., New York.

Shaper—Folder, describing 7-in. precision bench shaper.—Atlas Press Co., 1819 North Pitcher St., Kalamazoo, Mich.

Steam Purifiers—Publication No. 2725, describing steam purifiers.—Cochrane Corp., Philadelphia.

Tanks—Booklet, title "Wrought Iron in Tank Construction"—A. M. Byers Co., Pittsburgh.

Tires—Booklet, title "Industrial Tire Handbook," showing application of rubber-tired wheels.—The B. F. Goodrich Co., Akron, Ohio.

Tube Couplings—Bulletin 500, on self-flaring tube couplings.—Packless Metal Products Corp., 27-14 29th St., Long Island City, N. Y.

Tubing—Booklet, on properties of seamless mechanical tubing.—Timken Steel and Tube Division, The Timken Roller Bearing Co., Canton, Ohio.

Unit Heaters—Two bulletins: No. 284, on Projection heater; No 294, on Multiple Projection heater.—The Trane Co., La Crosse, Wis.

Valve—Folder, on Duravalve with integral Stellite seat.—Hancock Valve Division, Manning, Maxwell & Moore, Inc., Bridgeport, Conn.

Washfountains—Catalog No. 937, showing washfountains, showers, and drinking fountains.—Bradley Washfountain Co., Milwaukee.

Water Softeners—Bulletin No 602, on Zeolite water softeners and other water conditioning equipment.—Elgin Softener Corp., Elgin, Ill.

Welding—Booklet, title "The Inherent Requirements of the Arc Welding Generator and Their Application in the Hansen Smootharc Welder."—Harnischfeger Corp., 4400 West National Ave., Milwaukee.

Welding—Catalog, title "Arc Welding with the New 40-Volt Simplified Arc Welder."—Hobart Bros., Hobart Square, Troy, Ohio.

Wrenches—Booklet, title "How to Select and Use Wrenches."—J. H. Williams & Co., 75 Spring St., New York.

BOOKS

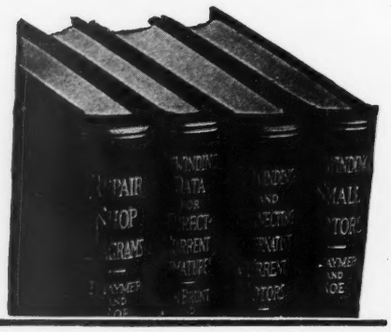
MODERN PLASTICS
Handbook and Catalog Number

E. F. Lougee, Editor. Breskin and Charlton Publishing Corp., 425 Fourth Ave., New York. 341 pages. $2.

Probably as complete a treatment of the field of plastics as can be had is to be found in this issue of Modern Plastics magazine. Its editorial content is presented under the divisions of materials, molding and fabricating, machinery and equipment, industrial and decorative laminated, product development, bibliography and nomenclature. In addition, there are a directory of trade names and a buyers' directory.

LABOR'S ROAD TO PLENTY

Allen W. Rucker. L. C. Page & Co., Boston. 221 pages, charts, index. $2.50.



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—change single-phase windings for two- or three-phase operation
—make cross or equalizer connections on lap windings
—lay out frog-leg windings
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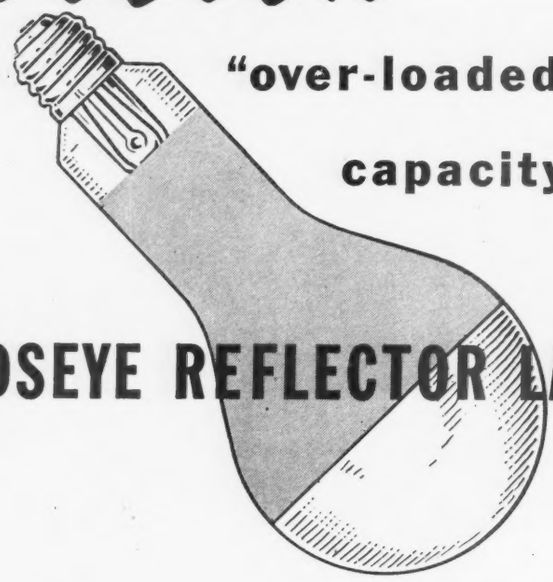

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COST ACCOUNTING

Charles Reitell, Staff Member, Stevenson, Jordan & Harrison and Teacher of Accounting, Columbia University; revised by C. E. Johnston, Director, Business Training Schools, International Correspondence Schools. International Textbook Co., Scranton, Pa. 425 pages, index. $3.50.

Second edition of this book on the principles and methods of cost accounting has new chapters on distribution costs, and chapters on standard costs have been entirely rewritten. The book's five parts are designated as basic cost principles, control and costing of manufacturing elements, process and job-order cost systems, standard costs and budgets, executive use of costs.

PRINCIPLES OF ACCOUNTING

Workbook, Ruled Forms, and Practice Set

Prickett and Mikesell. The Macmillan Co., 60 Fifth Ave., New York. "Workbook and Practice Set," $3.50. Ruled Forms No. 1," $1.

These three pieces are to be used with the authors' textbook as a home study course in accounting. The "Workbook" contains exercises based on the text and the "Practice Set" consists of forms to be used with it. Forms in "Ruled Forms No. 1" are for use in working problems in chapters I-XVI in the text. "Ruled Forms No. 2" will be published later.

•

ON THE CALENDAR

DECEMBER

5–9, National Association of Manufacturers, Annual Congress of American Industry and Annual Convention, New York, Noel Sargent, Secretary, 11 West 42d St., New York.

6–10, Annual Meeting, American Society of Mechanical Engineers, New York. C. E. Davies, Executive Secretary, 29 West 39th St., New York.

6–11, Sixteenth Exposition of Chemical Industries, New York. Charles F. Roth, International Exposition Co., Grand Central Palace, New York.

9–10, Annual Conference, The Society for the Advancement of Management, New York, Evelyn Buckley, Assistant Secretary, 29 West 39th St., New York.

14–15, American Management Association, Conference on Finance, New York. Alvin E. Dodd, President, 330 West 42d St., New York.

JANUARY

13–15, American Engineering Council, Annual Meeting, Washington, D. C. F. M. Feiker, Secretary, 744 Jackson Place, Washington, D. C.

24–28, American Society of Heating and Ventilating Engineers, Annual Meeting, New York. A. V. Hutchinson, Secretary, 51 Madison Ave., New York.

24–28, Fifth International Heating and Ventilating Exposition, New York. Charles F. Roth, Manager, International Exposition Co., Grand Central Palace, New York.

24–28, American Institute of Electrical Engineers, Annual Winter Convention, New York, H. H. Henline, National Secretary, 33 West 39th St., New York.

FEBRUARY

15–17, American Management Association, Conference on Industrial Relations, Chicago. Alvin E. Dodd, President, 330 West 42d St., New York.

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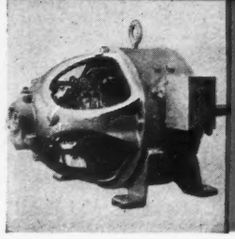

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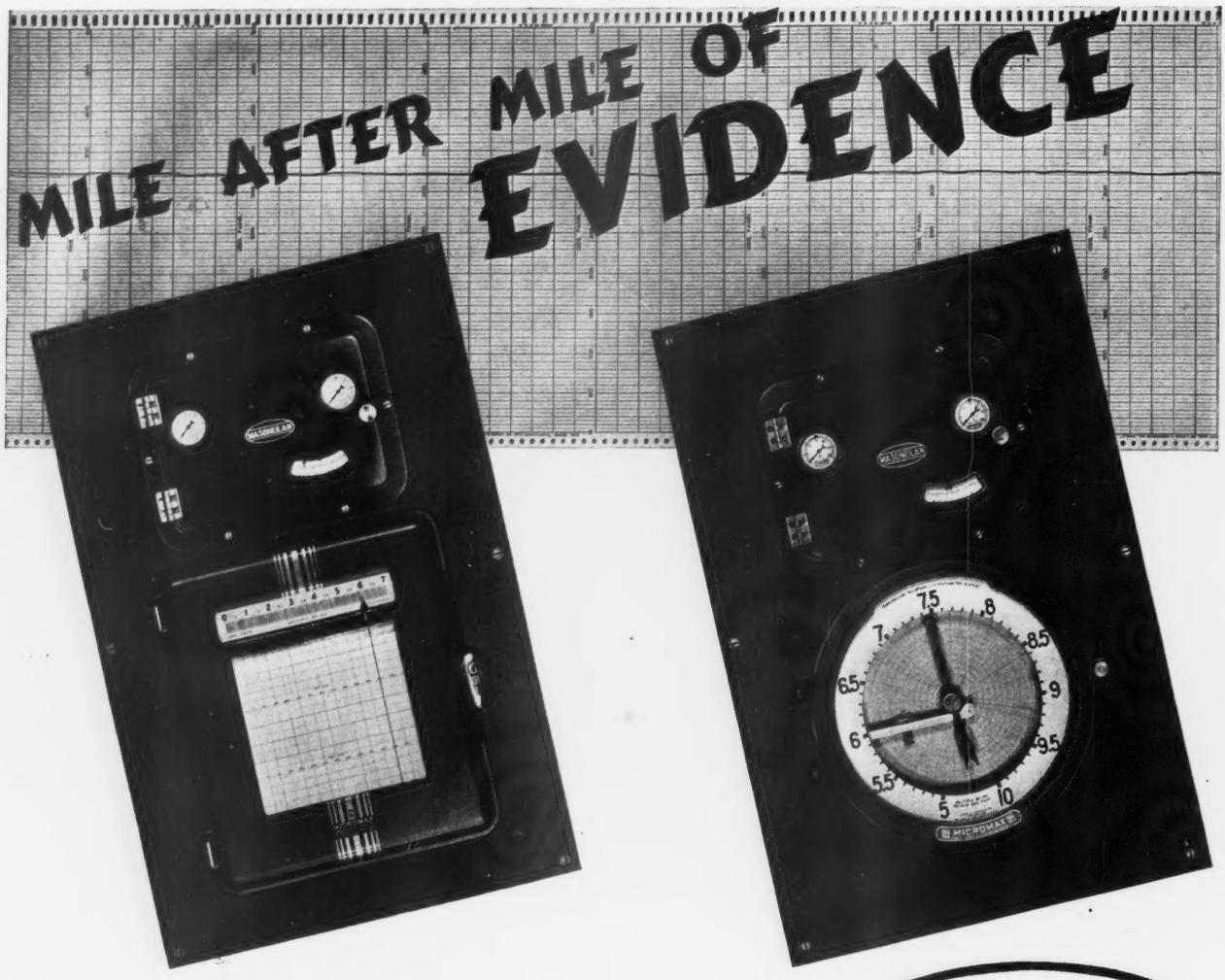

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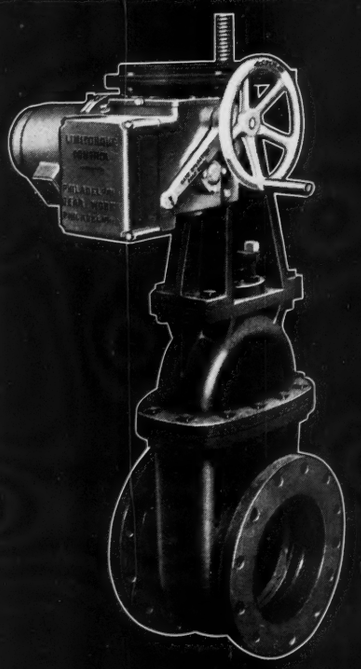

LIMITORQUE
AUTOMATIC VALVE
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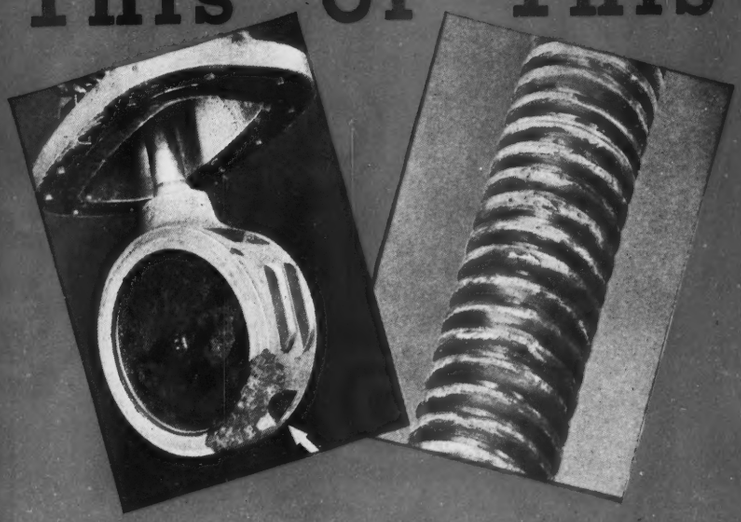
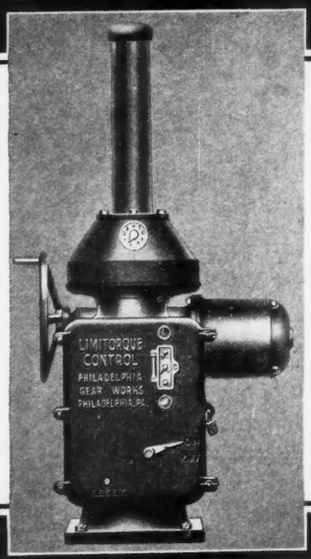
ON GUARD AGAINST This or This





For installations where it is not advisable to attach the control unit directly to the valve yoke, Floor Stand Controls can be supplied. Usually these are mounted directly over the gate stem although other locations are possible.

Bent Valve Stems . . . Valve Gates chipped or damaged otherwise, are serious matters that cause expensive replacements, inconvenient shut downs and general disruption of schedules. And, these are but some of the troubles that can follow improper valve seating or the valve gate's meeting an obstruction during the closing operation.

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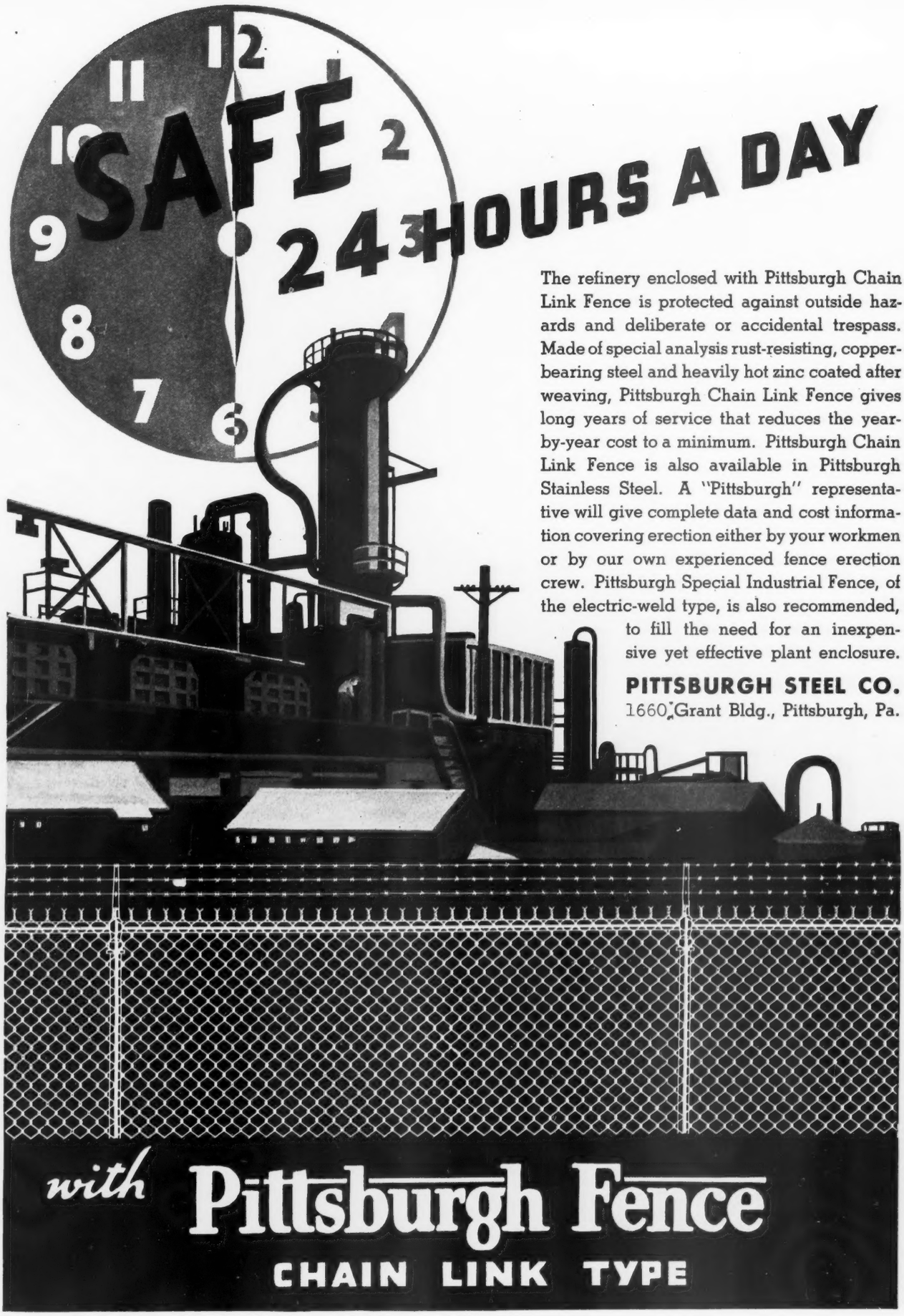
Brittle, dried-out wire insulation is a setup for him. When it's in that condition it falls easy prey to his quivers and shakes . . . cracks appear . . . and the pipe-stem hard insulation falls away. After that anything can happen ranging from a short to a costly equipment and labor tie-up, or even heavy property loss by fire.

But, you can trip the big boy up just as easily as you can order *Rockbestos*. Here's a wire insulated with *asbestos*. It can't dry out or crack because it's heatproof . . . *and that's why it's vibrationproof!* It's flameproof, too, and highly resistant to oil, grease, and corrosive fumes. Perhaps you have a spot in your plant where you can use some as a money-saver? May we send you samples or a catalog? Rockbestos Products Corporation, 869 Nicoll Street, New Haven, Connecticut.

Also refer to Electrical World Buyer's Reference Number for 1938.

ROCKBESTOS A.V.C.—*the wire with permanent insulation*



The refinery enclosed with Pittsburgh Chain Link Fence is protected against outside hazards and deliberate or accidental trespass. Made of special analysis rust-resisting, copper-bearing steel and heavily hot zinc coated after weaving, Pittsburgh Chain Link Fence gives long years of service that reduces the year-by-year cost to a minimum. Pittsburgh Chain Link Fence is also available in Pittsburgh Stainless Steel. A "Pittsburgh" representative will give complete data and cost information covering erection either by your workmen or by our own experienced fence erection crew. Pittsburgh Special Industrial Fence, of the electric-weld type, is also recommended, to fill the need for an inexpensive yet effective plant enclosure.

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One of the distinct advantages of Industrial Brownhoist Diesel cranes is the way they dig in and pull when the work gets hard — the way they travel at sustained speeds, up to 15 miles per hour.

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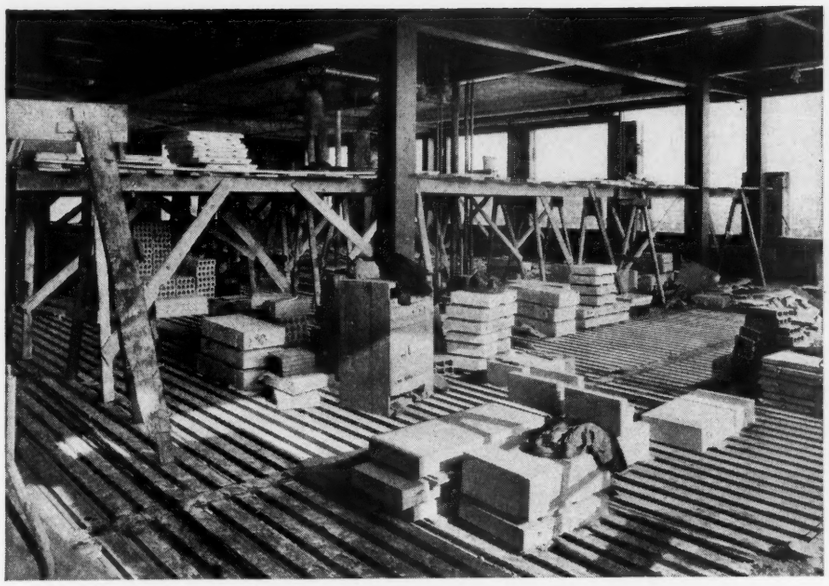

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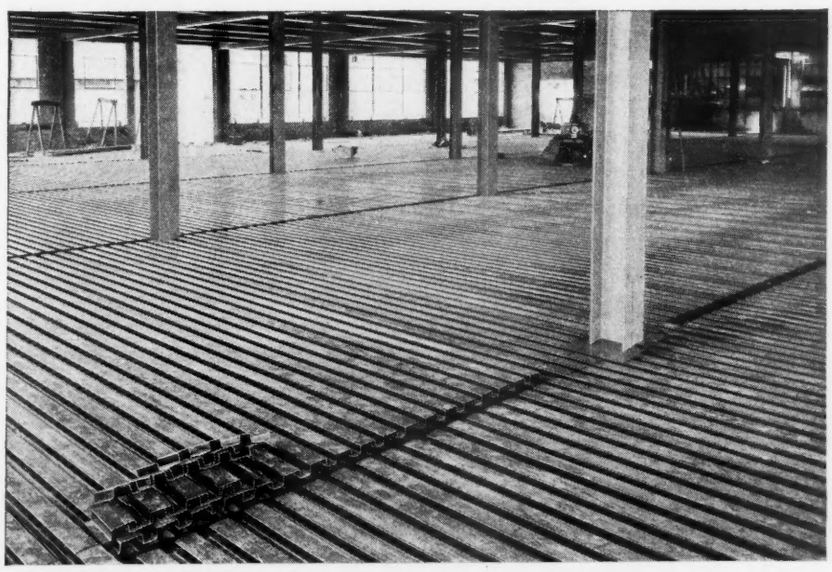

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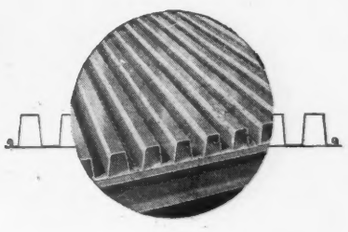

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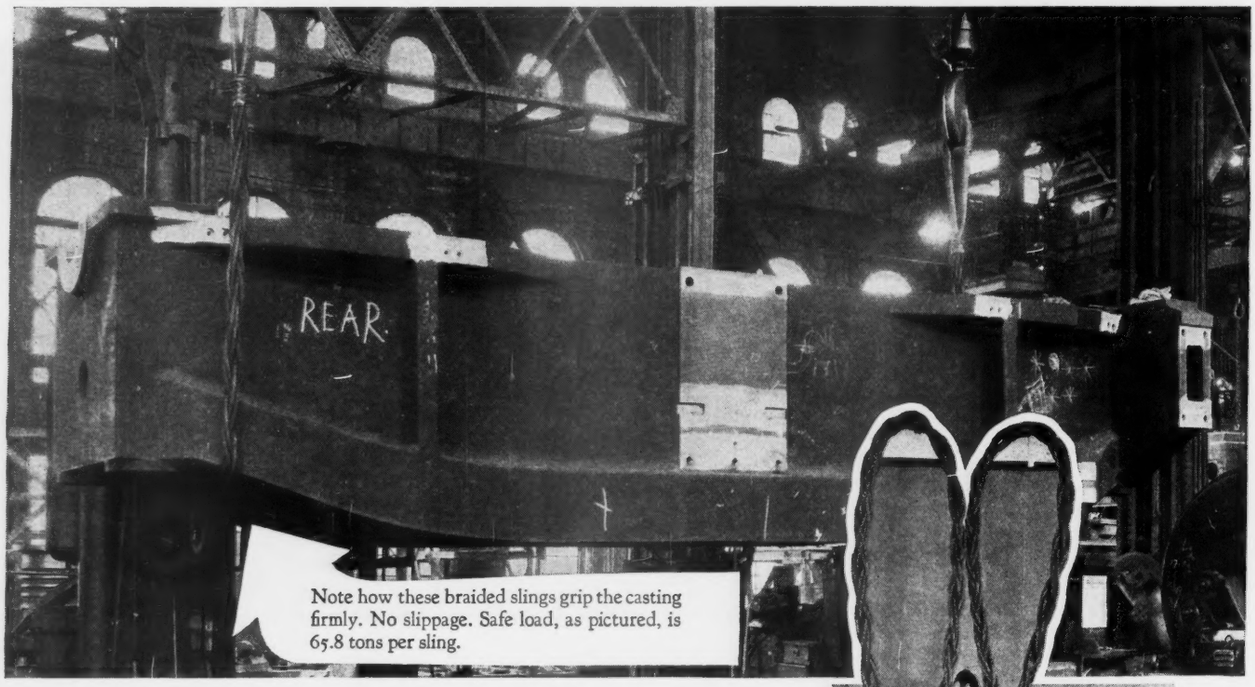

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NO. 269

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Because it was bothersome—confusing—not properly used by most drivers. Now the varying demands for speed and power are answered with automatic regulation of spark to gas intake. It is simpler, more efficient. You need no longer worry about spark advance and retard—it's done for you at the factory.

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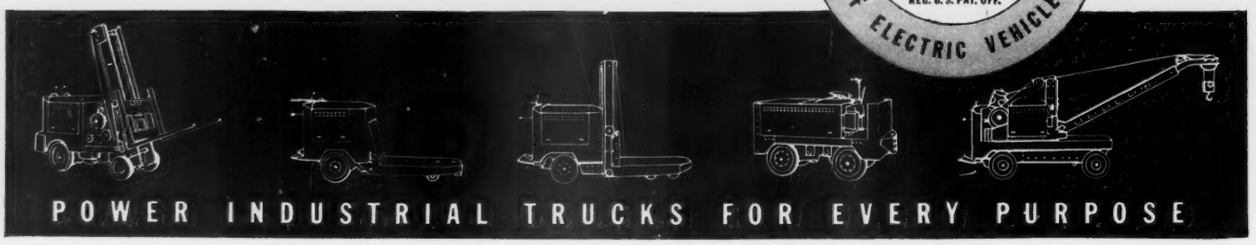

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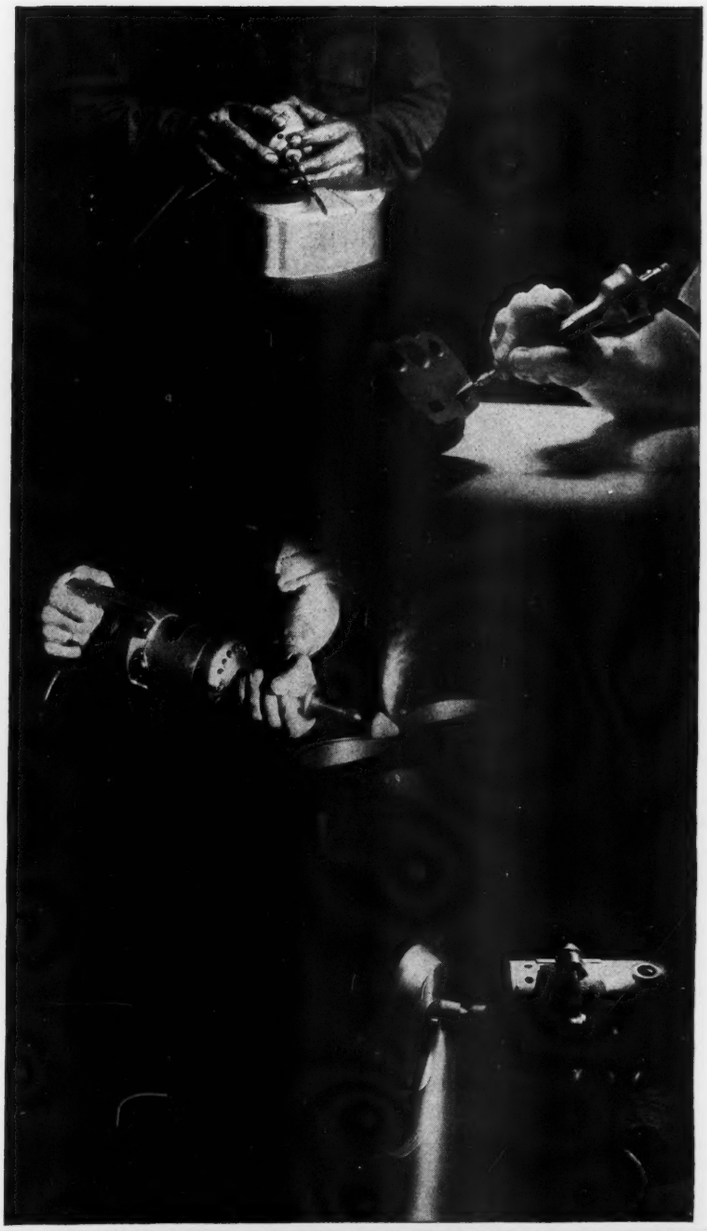

EVERY size and shape of mounted wheel and point that you can think of - - for the rough, heavy duty jobs - - for delicate finishing operations - - for electric, pneumatic or flexible shaft grinders. 38 Alundum Abrasive is especially effective on hard, tough die steels, cutting fast and free. For grinding cast iron, brass, bronze and similar metals, there are points and wheels of sharp Crystolon Abrasive.

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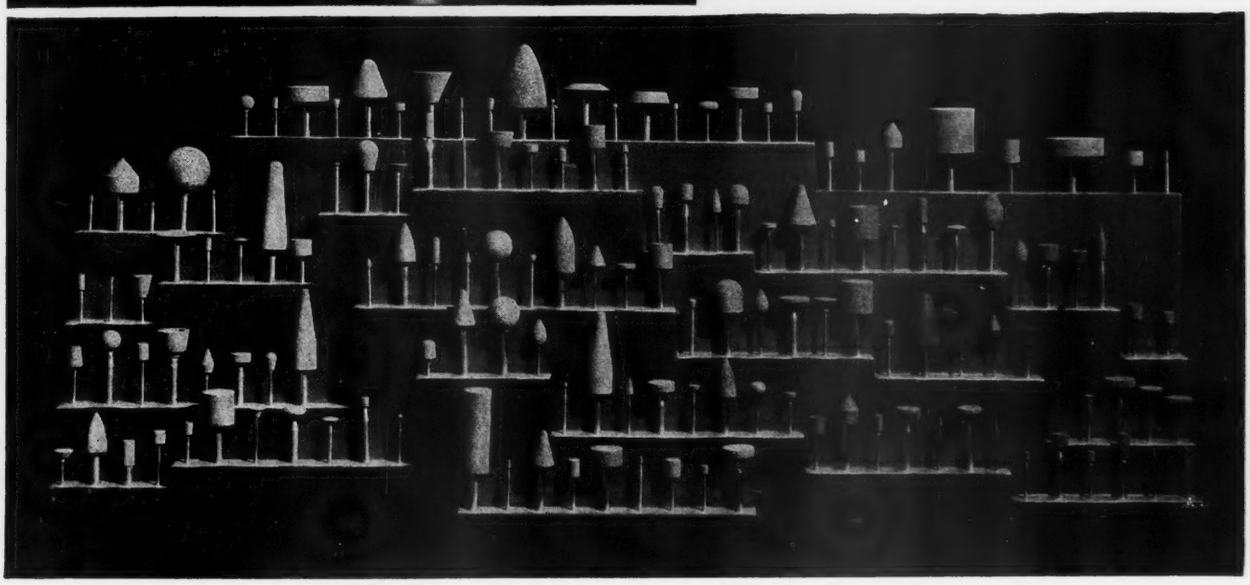

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You can save the time lost by workers in the mere physical act of "seeing" under usual plant illumination. By so doing you automatically make production more efficient and of more uniform high quality. Cooper Hewitt light can do this job for you most effectively. It is a detail-revealing, restful light that makes all seeing tasks easy. Errors that lead to rejects are eliminated and workers do not feel the common, costly end-of-shift fatigue from eye-strain.

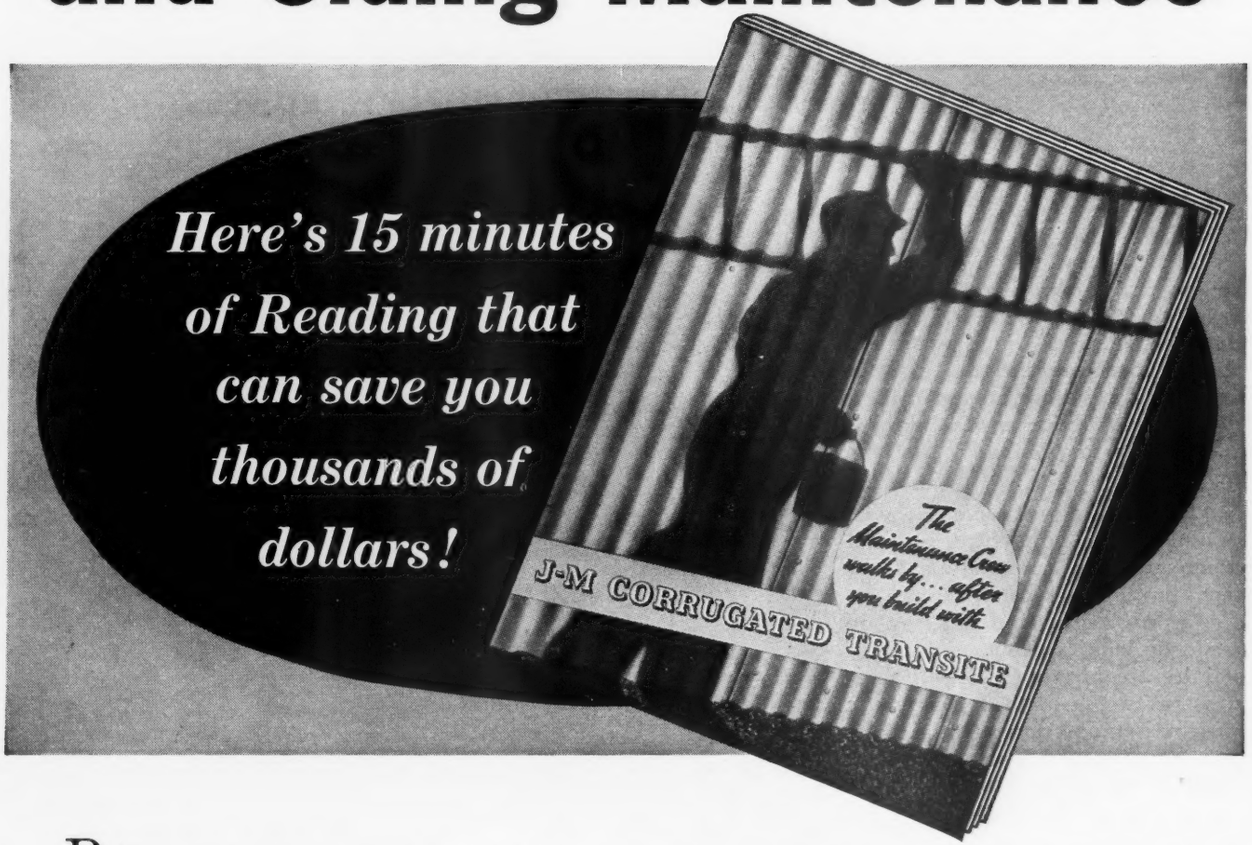
Cooper Hewitt light gives "better than daylight" to more than a million workers in every branch of industry. Its use is rapidly increasing. The new Cooper Hewitt Lamps give 22% more light with no increase in current. It will pay you to throw more light on production . . . with lighting engineered to fit the job. General Electric Vapor Lamp Company, 815 Adams St., Hoboken, N. J.

In this large machine department every inch of floor space is made equally useful through the uniform high levels of illumination provided by Cooper Hewitt light. A workman is never in his own shadow. He can see details anywhere, and works without eye-fatigue throughout the entire shift.

GENERAL ELECTRIC VAPOR LAMP COMPANY

851C

End Costly Roofing and Siding Maintenance


Here's 15 minutes of Reading that can save you thousands of dollars!
The Maintenance Crew walks by... after you build with
J-M CORRUGATED TRANSITE

PLANT OPERATIONS rough on roofing and siding? Annual painting, repair and replacement bills soaring?

Two very good reasons for learning more about J-M Corrugated Transite . . . and the quarter-century record it has established as an industrial building material of unmatched durability and economy.

Isn't it worth 15 minutes of your time to learn how and why? That's all it takes to read this new brochure, get the full story. To see how the fireproof asbestos-cement composition of Corrugated Transite provides resistance to corrosion, immunity to rot and imperviousness to weather or temperature changes.

You'll see, also, how Corrugated Transite's unique assembly method assures a water- and weather-tight construction. And how its quick, simple erection contributes initial savings that, combined with its low upkeep costs, make Corrugated Transite one of the most economical building materials now in use in the industrial world.

For the first step toward ending roofing and siding maintenance, mail the coupon today. Johns-Manville, 22 E. 40th Street, New York City.

. . .

IT BRINGS YOU FACTS YOU SHOULD HAVE!

JOHNS-MANVILLE, 22 E. 40th St., N. Y. C.
Send me your new Corrugated Transite brochure.
Name_____
Organization_____
Address_____
City_____ State_____
FMM-12-37

Johns-Manville
Corrugated Transite Roofing & Siding

NEW JENKINS 'ARMOR-SEAT'

Defeats Toughest Valve Enemies

This Jenkins Valve has a PLUG SEAT made of Jenkins JX500 stainless steel EXCEEDING 500 BRINELL HARDNESS

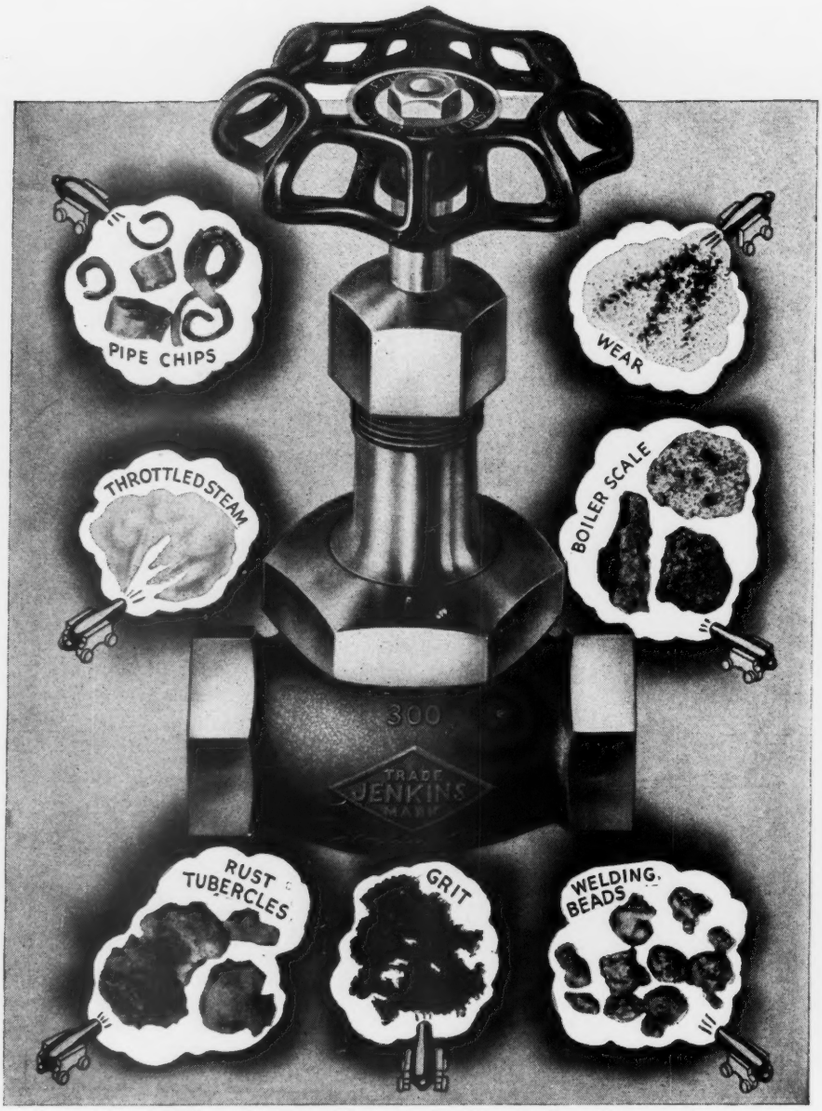
In presenting this Fig. 976 Plug-Seat Valve, Jenkins Bros. is confident that it is as near to being wear-proof, maintenance-proof and trouble-proof as a stock valve can be made. Back of it is a long period of development and testing to prepare it for the toughest services.

Natural enemies of valve seats such as boiler scale, pipe chips, grit and other substances commonly encountered in pipe lines, cannot injure the seating parts. Plug and seat ring are made of Jenkins JX500, a superior stainless steel having a Brinell hardness in excess of 500. Maximum wear-resistance is obtained and maintenance, due to seat damage, is reduced to the lowest possible degree.

Put this Jenkins to a service test on the worst place you know... continuous throttling for pressure reduction or free blow duty such as soot blowers, injectors, heating coils, or on any steam line where close regulation is required. Fig. 976 is specially recommended where such severe service is encountered. The JX500 plug and seat practically nullify wear and almost entirely eliminate danger of wire drawing and cutting.

If you have a tough valve job we ask only that you let this new Fig. 976 show what it can save you in maintenance and replacement expense. Ask your supply house for complete information, or write us.

JENKINS BROS., 80 White Street, New York; 510 Main Street, Bridgeport; 524 Atlantic Ave., Boston; 133 North Seventh Street, Philadelphia; 822 Washington Boulevard., Chicago; JENKINS BROS., Limited, Montreal, Can.; London, England



Illustrated is Fig. 976 for 300 lbs. W.S.P., or 600 lbs. O.W.G.

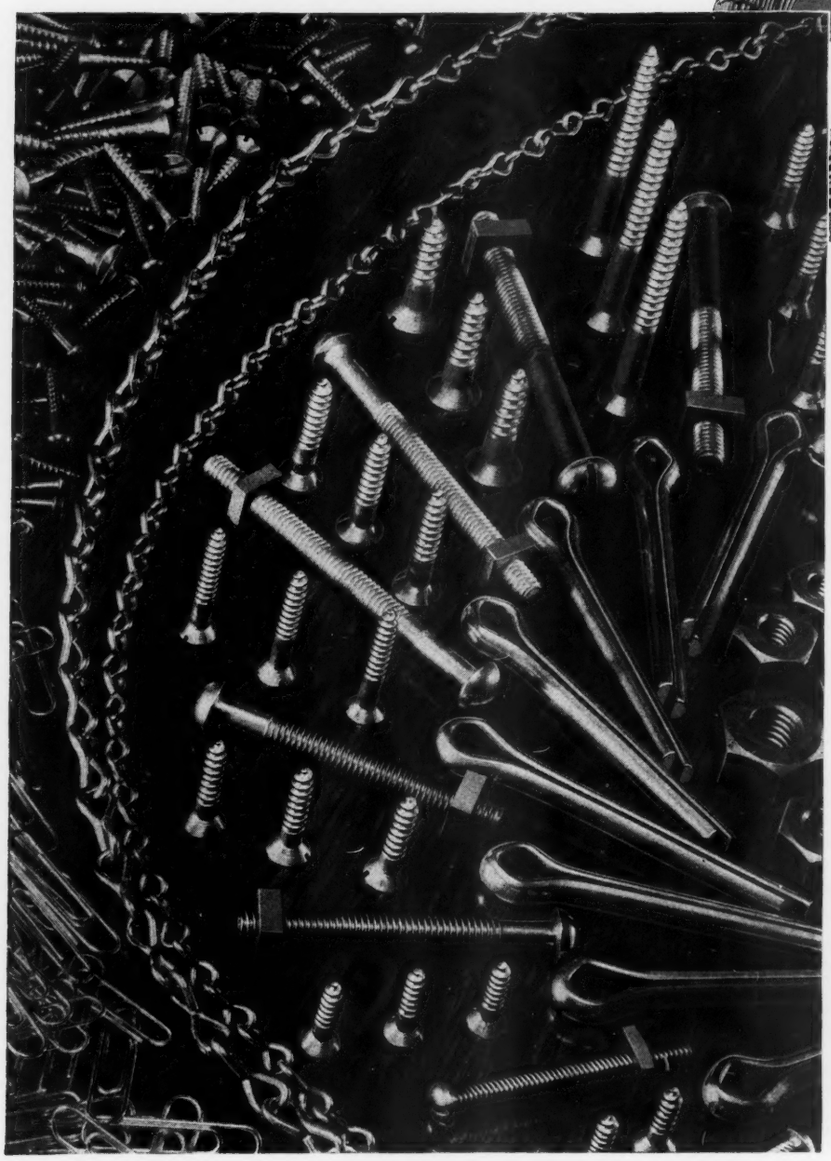
HOW HARD IS 500 BRINELL? Nothing that would conceivably get into the valve could scratch the Jenkins JX500 stainless steel seat. Compare 500 Brinell hardness with the hardness of some substances which do get into pipe lines... boiler scale, pipe chips, welding beads, rust tubercles, iron oxides... even with other familiar objects that are softer, such as a common nail which is under 200 Brinell hardness

Jenkins Valves MADE FOR LIFETIME SERVICE

TAKE THIS STEP TOWARD

Trouble-free

PRODUCTION



PRODUCT prestige depends to a great extent upon the kind of materials used in manufacturing. Unless the wire you use in your production is of high quality, uniform in both metallurgical and physical properties, even the best of production equipment and expert workmanship cannot result in products that are consistently high in quality.

Manufacturers Wire made by the American Steel & Wire Company is uniform in those characteristics important to trouble-free production and satisfactory performance of your product. Our workmen, our excellent facilities, our use of only the best of raw materials . . . plus long wire-making experience . . . are guarantees to you that when you use American Quality wire, you can rely on it to help you make a product of high quality.

American Quality Wire is available in a wide range of sizes, grades, shapes and analyses. Let our engineers help you determine which wire will do the best job for you.

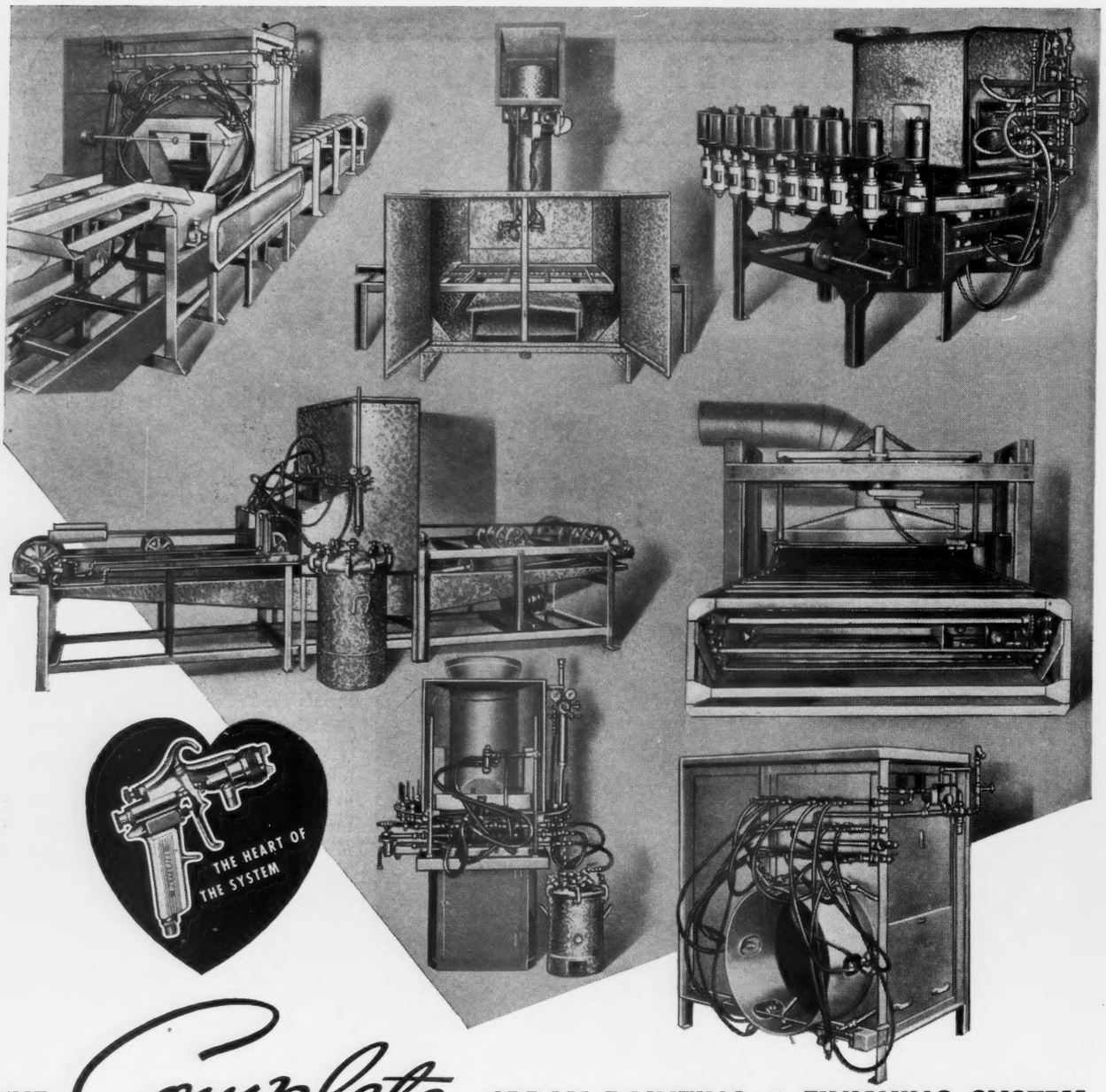
U·S·S AMERICAN QUALITY WIRE

AMERICAN STEEL & WIRE COMPANY

Cleveland, Chicago and New York

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* • United States Steel Products Company, New York, *Export Distributors*

UNITED STATES STEEL



THE *Complete* SPRAY-PAINTING & FINISHING SYSTEM

The complete DeVilbiss Spray-Finishing System includes a broad variety of special equipment for high speed production line finishing or coating of objects small and large from lip-stick holders to steel sheets . . . DeVilbiss engineers almost daily design special spray guns, nozzles, spray equipment and accessories, automatic and semi-automatic machines and exhaust equipment for use with unusual finishing materials, for operation under difficult conditions or to meet some special production necessity. Years of development in standard and special equipment have solved almost every kind of finishing problem. But new products, finishing materials and operating methods constantly present new equipment requirements . . . The DeVilbiss engineering staff, research and experimental laboratories and a nation-wide organization of experienced field representatives are always available to help you solve your finishing problems no matter how simple or complicated they may be.

SPRAY GUNS · MATERIAL CONTAINERS
REGULATORS · SPRAY BOOTHS · EXHAUST
FANS · AIR COMPRESSORS · HOSE AND
HOSE CONNECTIONS · ACCESSORIES

DeVilbiss

THE DEVILBISS COMPANY · TOLEDO · OHIO

Continuous, Low-Cost Crane Service is the **Tiger's** *task in steel mills*

WHITING Tiger CRANE

Dependable, low-cost overhead transportation is necessary these days for economical production in any industrial plant, but doubly necessary in a steel mill. Nowhere is a crane subjected to harder usage than in steel mills. The fact that Tiger cranes are giving excellent performance in steel-mill duty, operating without shut-downs, with less power consumption and a minimum of maintenance expense, is proof of their ability to "do the job" in any plant. Let us show you how Tiger cranes can help you earn greater profits by cutting down handling costs.

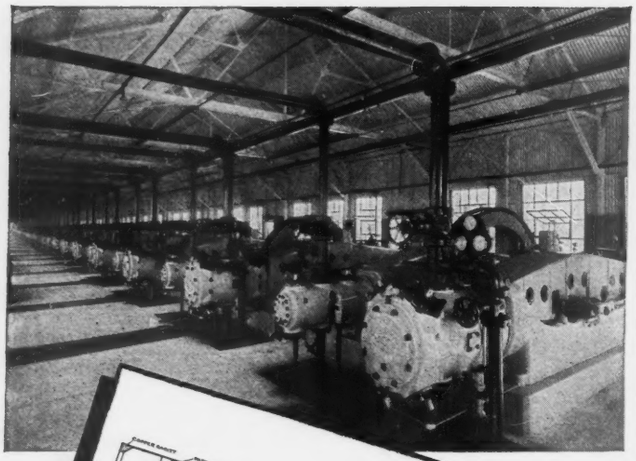
Send for Catalog No. 300

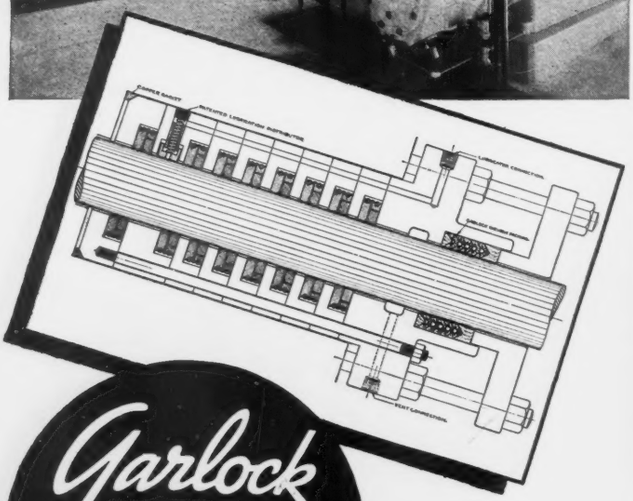
WHITING CORPORATION, 15689 LATHROP AVE., HARVEY, ILL.

Electric Traveling Cranes
Foundry Equipment
Railroad Equipment
Pulverized Coal Machinery
Stokers—Special Machinery

WHITING

PIONEERS SINCE 1884





Garlock METAL Packing

Above: A modern compressor station. *Below:* Typical installation of GARLOCK 875 Combination High Stage Gas Compressor Metal Packing.

GARLOCK Metal Packings are giving dependable, year-after-year service on all kinds of compressor rods, gas engines, steam engines, pumps and other equipment where metal packings are desired. Correctly designed by metal packing engineers and precision built of the finest, selected metals, GARLOCK Metal Packings are as economical as they are efficient.

Write for Catalog!

THE GARLOCK PACKING CO.
PALMYRA, N. Y.

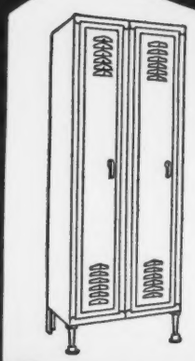
In Canada: The Garlock Packing Company of Canada, Ltd., Montreal, Que.

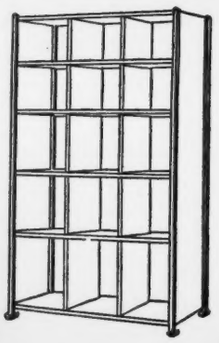
1887-1937 FIFTIETH ANNIVERSARY

GARLOCK

MEDART

STEEL LOCKERS *and* STEEL SHELVING





There's a difference!

Write for Catalogs

FRED MEDART MANUFACTURING CO.
3544 DEKALB ST. ST. LOUIS, MO.
Sales Engineers in All Principal Cities — Consult Your Telephone Directory

RIGHT TYPE *for* EVERY SERVICE

TURBINE PUMPS

CENTRIFUGAL PUMPS

RECIPROCATING PUMPS
Simplex and Duplex Types

Somewhere in this broad line of modern, highly-efficient Turbine, Centrifugal and Reciprocating Pumps is exactly the equipment you need, no matter what your pumping problem. American-Marsh engineers can help you get results with UTMOST economy. We have done it a thousand times before! Write us for bulletins.

To better associate our Company name with our long established trade name—American-Marsh—we recently adopted the new Company name used in the signature below.

However, there has been NO CHANGE in financial structure, management, or quality standards maintained for over 60 years.

AMERICAN-MARSH PUMPS, INC.
Centrifugal, Turbine, Steam, and Power Pumps
BATTLE CREEK . . . . MICHIGAN

WEATHER BITES DOG!

This *is* news. The hot dog is another one of weather's victims. And atmospheric conditions in a sausage factory must be watched and *controlled* or the "dogs" break out with the rabies.

And the other parts of these Coney Island hors d'oeuvres have *their* weather problems. The roll is better if the dough ferments and the crust cools in a fairly humid room. The butter in which the roll is toasted should be churned in cool, moist air. And the mustard—like all spices—must be watched in the grinding process and done where it's cool and dry.

There in a nut shell is the amount of air conditioning that goes into a ten cent banquet. Other products from yeast cakes to theater curtains have similar climate favorites. And finding these climates and installing them for manufacturers—large and small—has been our business for over thirty years.

Let our engineers show you how Parks Certified Climate opens the door to better production, fewer rejects and lower costs. Write.

PARKS

Certified Climate

PARKS-CRAMER CO., FITCHBURG, MASS. . . . CHARLOTTE, N. C.

The odds are—

98 to 1

a standard LO-HED Hoist will meet your MHP*

- Although your particular "M H P" (*Materials Handling Problem) may be distinctly different from the handling problems of other companies—you will save money if you can use *standard* hoists.
- Your chances are 98 to 1 that a *standard* A-E-CO Lo-Hed HOIST will prove to be perfectly suited to your needs.
- Why? Because there are 98 *standard* models of A-E-CO Lo-Hed HOISTS—models for *every* purpose, and in a wide range of capacities, speeds and types.
- Our new catalog clearly shows you how to select *the* hoist for *your* job. Send for it!

A-E-CO LO-HED HOISTS

AMERICAN ENGINEERING COMPANY

AMERICAN ENGINEERING COMPANY
2426 Aramingo Avenue, Philadelphia, Penna.

Gentlemen: Please send me your complete new catalog showing how to select a LO-HED hoist.

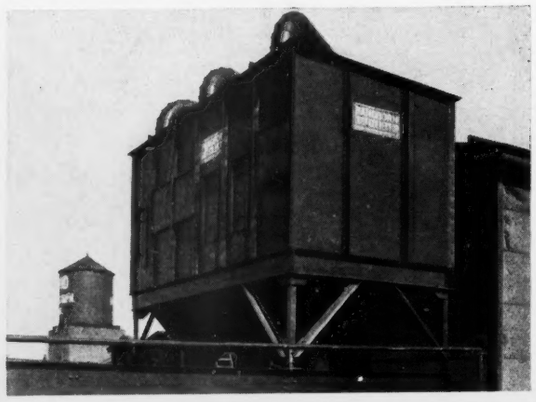
*Name of Company*_____

*Company Address*_____

*Your Name*_____

*Your Title*_____

Other Products: A-E-CO Taylor Stokers, A-E-CO Hele-Shaw Pumps, Motors and Transmissions, A-E-CO Marine and Yacht Auxiliaries.



DUST CONTROL

costs surprisingly little . . . . pays visible dividends . . . . wherever Pangborn all-metal frame, cloth filter Dust Collectors are specified

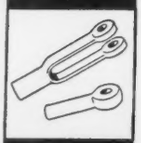
Pangborn Dust Collectors are known and specified by industry all over the world. From the smaller sizes to those serving the largest plants in the country, PANGBORN DUST COLLECTORS mean continuous satisfaction, elimination of worry, and reliable protection from all DUST hazards. Dust problems END with PANGBORN. Let us prove this in your plant. A size and type for every Dust Control requirement.

PANGBORN

WORLD'S LARGEST MANUFACTURER OF DUST COLLECTING AND BLAST CLEANING EQUIPMENT
PANGBORN CORPORATION . . . HAGERSTOWN, MARYLAND

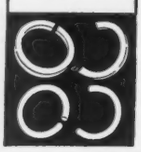
SPRING WASHERS

Spring washers and lock washers of every type and size, including the well-known Hipower and Kantlink types. There are thousands of more places where spring washers would improve the value of any product where bolts, nuts, cap or machine screws are used.



STEEL ROD ENDS

Drop forgings including steel rod ends of the adjustable yoke, plain yoke, and eye types. These articles in standard sizes and threads afford tremendous savings over special designs.

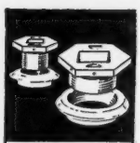


RETAINING RINGS

Spring retaining rings of special heat-treated spring steel are carried in many stock sizes—both open and closed types. Use of a spring retaining ring is an excellent manner of creating a shoulder on a shaft.

STEEL BARREL CLOSURES

Forged and machined fittings for steel barrels, drums, tanks and metal packages, including plugs, rings and flanges. Very rugged for use in transportation of alcohol, turpentine, oils and other expensive liquids.



CONTAINER HANDLES

Forged steel handles for heavy containers—can be rigidly welded, riveted or attached by a strap to lie flat when not in use. Rugged and most satisfactory for hard usage.

RHEOSTATS—RESISTORS—LOAD BOXES AND SPECIAL APPARATUS

Our electrical division—Hardwick, Hindle, Inc.—makes as fine electrical resistance products, fixed and variable, as can be devised.

Other products include windows for buses and railway cars, railway car window curtains, curtain rollers and fixtures, sash locks and lifts.

THE NATIONAL LOCK WASHER COMPANY
NEWARK, N. J.—EXPORT DIV., 15 E. 26 ST., N. Y. C.

The C. F. Pease Company *Changes* FROM WOOD TO STEEL

Insures Orderly, Efficient Storage in New Modern Plant With LYON Steel Shelving

● Having experienced the problem of expanding inflexible built-in wooden storage equipment to keep pace with a rapidly growing business . . . The C. F. Pease Company, Chicago, manufacturers of Blue Printing Machinery, sought the most flexible and efficient shelving obtainable for their new, up-to-the-minute plant. Lyon Steel Shelving was selected. Its contribution to compact and orderly storage of bars and tubing . . . factors that speed up handling and conserve floor space . . . are clearly indicated by these views of their raw material stockrooms. Lyon Steel Shelving holds down storage and materials handling costs in all departments. It can be loaded heavily . . . re-adjusted without waste . . . expanded at any time to keep pace with mounting production . . . is equally adaptable to new or old stockrooms, toolrooms and warehouses. Use the coupon to secure detailed information.

LYON STORAGE EQUIPMENT *Service*

LYON METAL PRODUCTS, INCORPORATED, *Aurora, Illinois*

LYON METAL PRODUCTS, INCORPORATED
1212 River Street, Aurora, Illinois

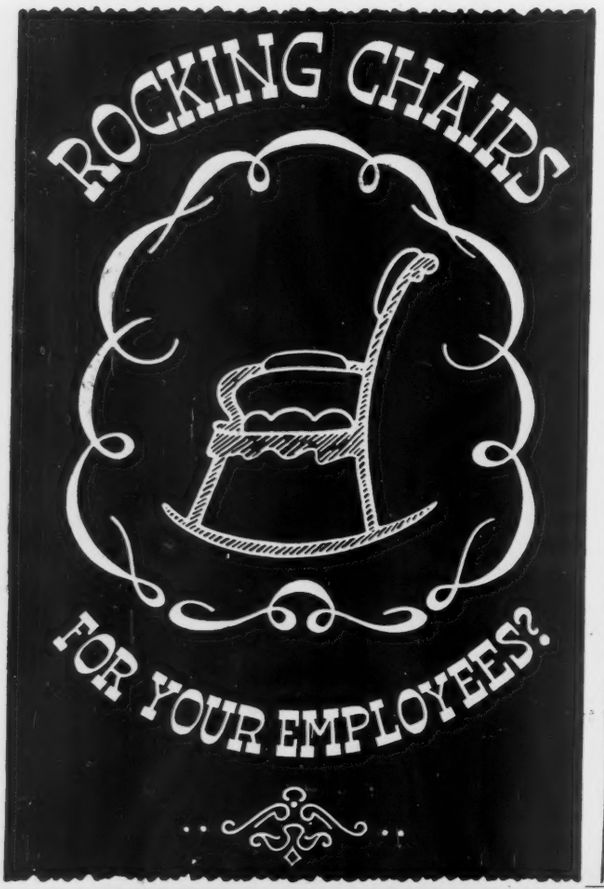
Send me complete information as checked:

☐ Steel Shelving ☐ Shop Boxes ☐ Work Benches
☐ Toolroom Equipment ☐ Bar Racks ☐ Shop Equipment
☐ Storage Equipment Engineering Service.

Name _____

Address _____

City _____ *State* _____



YOU may laugh. But—take a look around your plant and likely as not there are plenty of wobbly stools—as little conducive to productive work as the Rocker would be.

Better equip with "Hallowell" Stools of Sturdy Steel. They are wobble-proof being a *welded unit* throughout—and have comfortable seats that make work easy.

Fig. 1334. "Hallowell" Steel Stool. Dished wooden Seat 14½" dia. Heights: 14" to 36" incl. stepped up by 2". Welded throughout. Finish: Rich Olive Green Enamel.

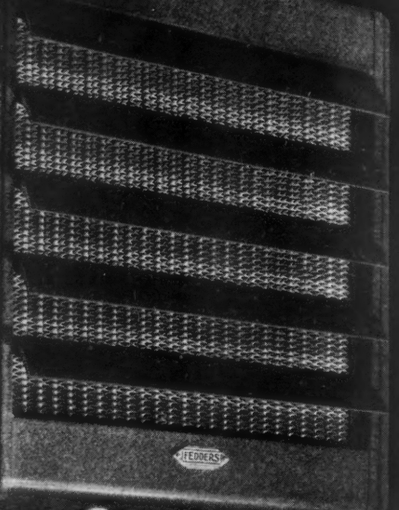
Fig. 1249. H. B.—"Hallowell" Steel Stool. Dished wooden Seat 14½" dia. Heights: 14" to 30" incl. stepped up by 2". Adjustable Spring Posture-Back. Hinged Back-Rest. Welded throughout. Finish: Rich Olive Green Enamel.

Fig. 1334 Fig. 1249 Pat. Appl'd. For

STANDARD PRESSED STEEL CO.

BRANCHES BOSTON DETROIT INDIANAPOLIS — JENKINTOWN, PENNA. BOX 546 — BRANCHES CHICAGO ST. LOUIS SAN FRANCISCO

HEAT TRANSFER SPECIALISTS SINCE 1896



To every man who knows

GOOD DESIGN . . . . . .

Believing that the performance you get out of a unit heater is the result of the engineering that goes into it, Fedders presents a few of its many features that have won the approval of heating men from coast to coast.

Exclusive Full-Floating mountings permit free movement of the heating element vertically in cabinet and also protect it from torsional stresses. 3 to 1 streamline tubes and individual convoluted fins allow each tube to "give" laterally, thus relieving differential expansion stresses within the element. Non-diaphragmatic headers assure a stable heating element. Fedders convoluted fins are saddled over sides of tubes to eliminate heat expansion stresses between fin and tube bonding points, thus maintaining lifetime thermal bond.

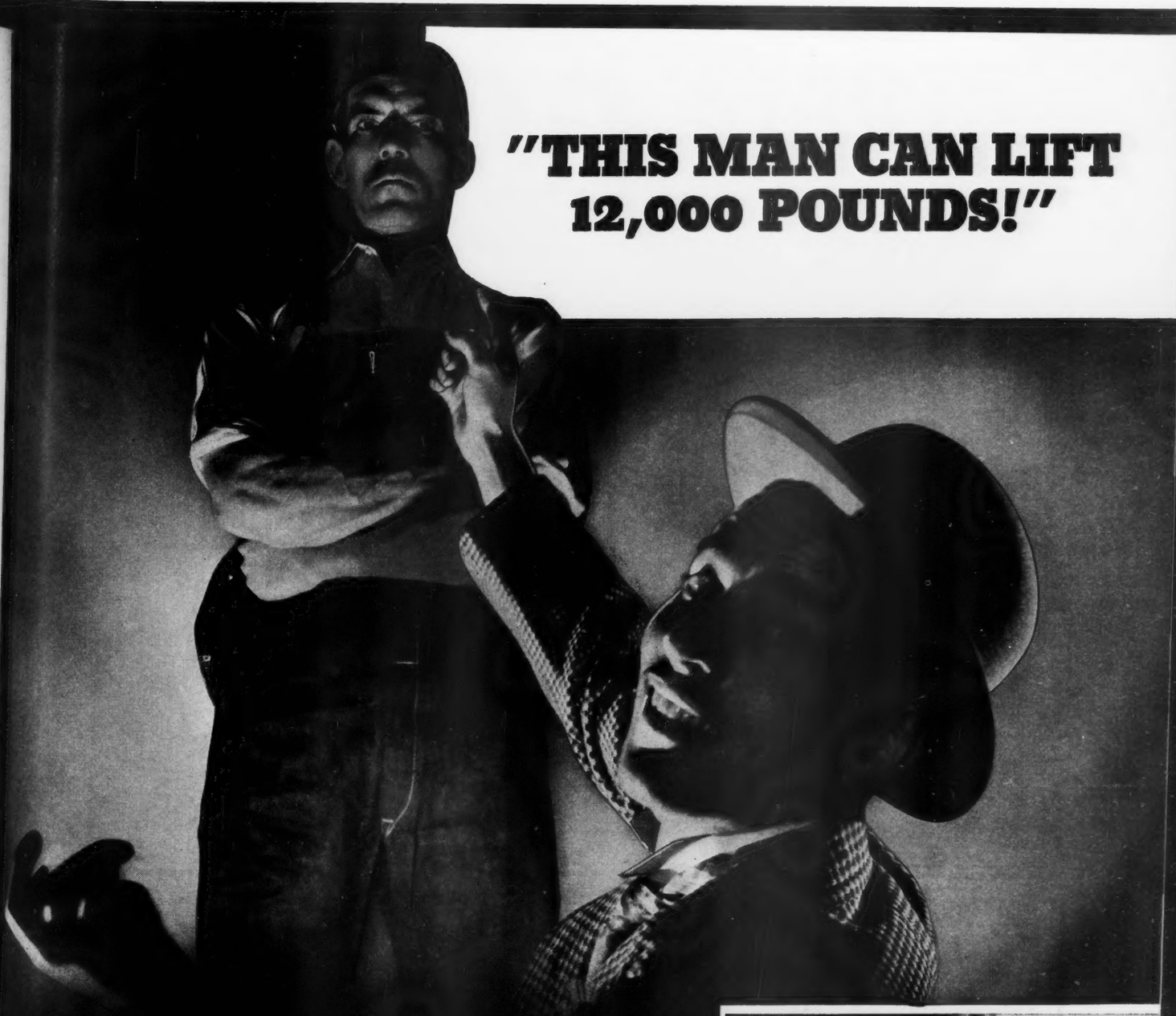
Quieter operation and handsome, sturdy mono-piece cabinets make Fedders Unit Heaters ideal for commercial as well as industrial applications. Write for Bulletin 572.

FEDDERS MANUFACTURING CO.
Buffalo, N. Y.

All Season Air Conditioning Units—Blast Heating and Cooling Surface

FEDDERS

"THIS MAN CAN LIFT 12,000 POUNDS!"



WITH A YALE TRUCK, of course

Just think of it . . . Every man in your plant with the potential working power of a giant! His production possibilities increased as high as 80% . . . his health and safety guarded 100% . . . if he's working with a YALE truck!!

YALE trucks hold the blue ribbon in their field. Inefficient, faulty trucks are just as bad as no trucks at all. YALE units have no faults . . . no weakest part to break down under excessive strain!! They are built to endure!!

Lifting . . . Hauling . . . Stacking . . . Storing . . . For years, YALE has been supplying equipment to meet the plant operator's every problem in these branches of his operating activity . . . Superior quality equipment which reflects YALE'S years of experience in the field!!

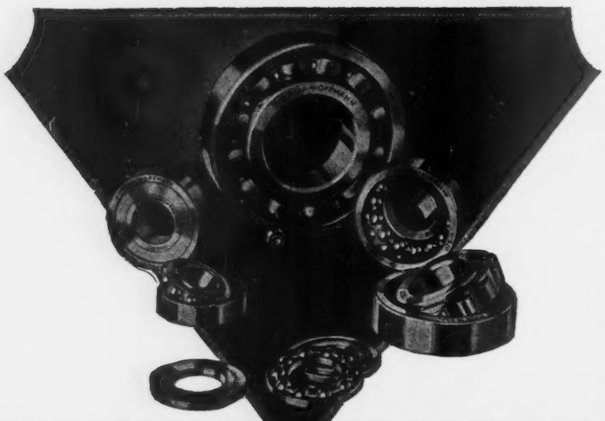
Economical . . . Efficient . . . Speedy . . . Safe . . . A YALE trucking system is your guarantee that you're getting the greatest return out of every handling dollar spent!!

Let a YALE representative show you the way to larger profits through increased manpower efficiency!!

TRADE YALE MARK

THE YALE & TOWNE MANUFACTURING COMPANY,
PHILADELPHIA DIVISION, PHILADELPHIA, PA.
IN CANADA: ST. CATHARINES, ONT.

100,000 STARTS



PRECISION BEARINGS

in 108 Distinct Series

NORMA-HOFFMANN offers, to engineers and designers, the most comprehensive line of anti-friction bearings in America:—108 series—ball, roller, and thrust types—1/8" to 21" bore, metric and inch sizes—a **PRECISION BEARING** for every load, speed, and duty. Write for the latest Catalog. Let our engineers work with you.

NORMA-HOFFMANN BEARINGS CORP'N.
STAMFORD, CONN., U. S. A.

"NORMA-HOFFMANN"
PRECISION BEARINGS
BALL • • • ROLLER • • • THRUST

CONTINENTAL *Chain Link* FENCE

HEAVIER—STRONGER
... Posts and fittings larger ... 35% more fabric ties ... heavier rails and bracing ... fabric of KONIK, a stronger steel — rust-resistant clear through. Erected complete, if desired, by expert Continental crews. Manual on "PLANNED PROTECTION" ... Free.
CONTINENTAL STEEL CORP.
Kokomo, Indiana
Plants at Kokomo, Indianapolis, Canton
FABRIC OF
KONIK
STEEL
CONTAINING COPPER, NICKEL, CHROMIUM FOR GREATER STRENGTH AND RUST RESISTANCE

RUTS—HOLES

and Broken Out Places in Your

FLOORS

can be repaired quickly with

STONHARD RESURFACER

The World's Standard Floor Resurfacer

MORE THAN 40,000,000 SQUARE FEET IN USE ALL OVER THE WORLD

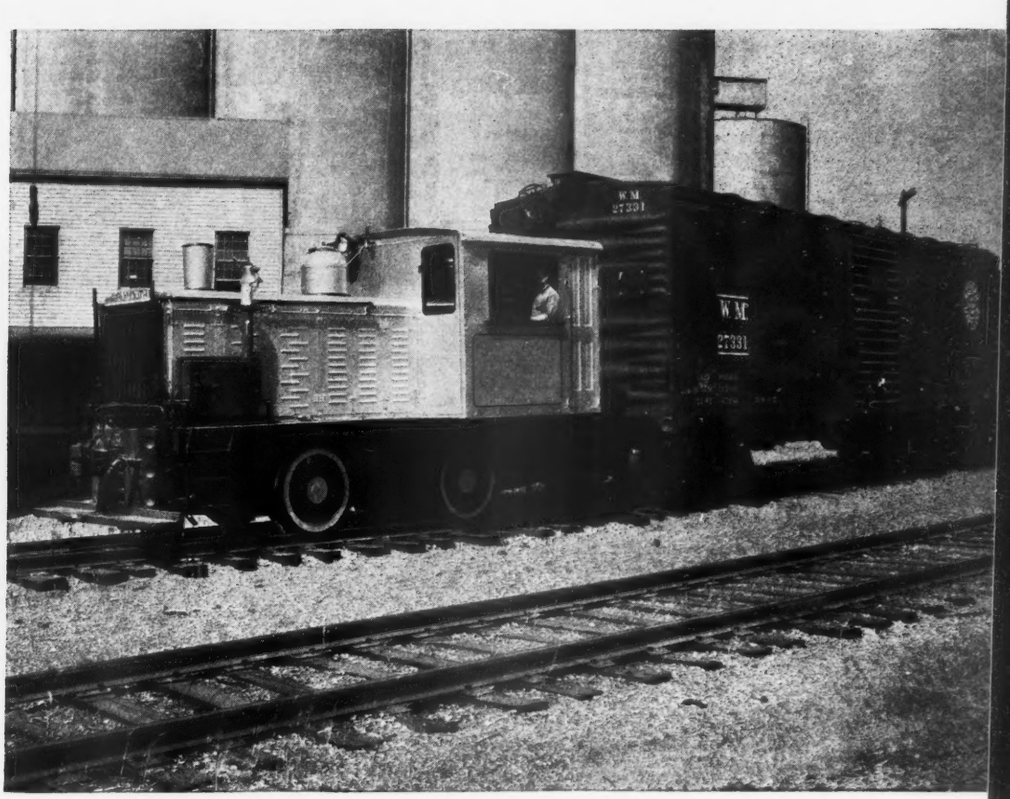
Your company is entitled to a *Trial Demonstration* at your plant. Write today for details. No obligation.

806 Terminal Commerce Bldg.
Philadelphia, Pa.

STONHARD COMPANY

103,680 STARTS AND STOPS

What a Transmission!



103,680 Starts and Stops in 90 Days!

Total Fuel and Maintenance $1.81 Per Day!

7 years' average ... all year service

HERE'S THE STORY!

● During the grain storing season the National Milling Company division of the NATIONAL BISCUIT CO. switches 24 hours a day, seven days a week for a period of approximately three months. THE GRAIN MUST MOVE. Eight cars per hour through the car dumper -- six stops and starts for each car movement -- 103,680 starts and stops in 90 days for the sturdy Plymouth Switcher -- and the rest of the year handling the ORDINARY yard switching.

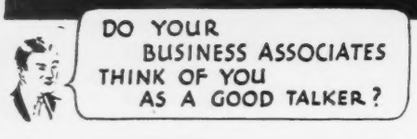
NO FAILURE OF ANY PART OF THE FAMOUS PLYMOUTH TRANSMISSION IN SEVEN YEARS. AND ONLY ONE CLUTCH REPLACEMENT.

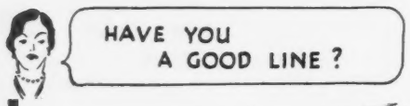
Your service probably isn't this tough but here is a vivid picture of what these sturdy little switchers can take. If you want economical haulage, check into Plymouth's Proven Performance!

PLYMOUTH LOCOMOTIVE WORKS
(Division of the Fate-Root-Heath Company) - PLYMOUTH, OHIO

PLANT SWITCHING *is cheaper with* PLYMOUTH
GASOLINE • DIESEL • ELECTRIC • BUTANE • PROPANE
LOCOMOTIVES

MAKE YOUR TABLE-TALK WIN YOU FURTHER INVITATIONS
DO YOU HAVE TO TALK ABOUT THE WEATHER?
DOES YOUR BOSS DRUM ON THE TABLE WHEN YOU TALK IN MEETINGS?
HOW'S YOUR COME-BACK?
CAN YOU SAY IT WITH GRACE AS WELL AS TO GRACE?
Make them say "You said it!"





How often do you gain heart-felt approval of what you say? How effective is your everyday conversation? Are people won over to you when you talk?

Because relations with people are so large a part of your daily life, in business and social activities, the ability to talk is your most important asset in keeping these relations smooth and in winning people over to your ideas. And the better you talk, the greater will be your success.

"I say without hesitation, this is the best book on conversation ever written." — ALBERT EDWARD WIGGAM

"Will help all who wish to be able to carry on an interesting conversation." —*Liberty*

Milton Wright's

THE ART OF CONVERSATION

And How to Apply Its Technique

Already in its fourth big printing—$2.50

IF you would win an argument or win a wife, cultivate a friend or humble an enemy, get information or give it, ask a favor or deny one, land a job, sell a bill of goods, be elected to office—if you would accomplish anything, at work or at play, where you are in the presence of other human beings, then you must talk.

So that you may learn how to talk to the best advantage in any situation, Milton Wright has written this book. He shows you—not merely tells you, but *shows* you—how to start a conversation, how to keep it going, how to direct it the way you want it to go, how to make precisely the impression you want to make and get exactly the result you want. He analyzes repartee and shows you how to develop facility in using it. He takes actual conversations apart and shows you what makes them tick.

Mr. Wright's book is firmly grounded in psychology and is written in his easy-to-read style. You can't help setting yourself in the places of the people who do the talking, and when you've laid down the book, you want to go out and practice on your friends. It's a fascinating book—interesting, practical, and really helpful.

How to acquire the ability to talk— *readily entertainingly convincingly*

Are people won over to you when you talk? They will be if you understand and apply the technique of conversation. This book is a brass-tack analysis of talk today—its principles—its techniques. It is a fascinating, practical discussion of simple exercises which will improve everyday conversation.

How would you work out these problems?

—How would you keep up the interest of a group for fifteen minutes in a topic selected by you? (See page 28)

—How would you discover a special interest of a person you have met for the first time? (See page 74)

—What steps would you take in a talk with just one other person to insure his wanting to talk with you again? (See page 111)

—How would you start, keep moving, and control the conversation at a dinner party of six? (See page 149)

10 days' Examination

Send this Coupon

TRY WRIGHT'S METHODS FREE

Check the list of conversational offenses on page 320; see how plainly Wright shows how to overcome these faults. You can make this test, read Wright's book, put his method right into practice, without obligation, simply by mailing the coupon. Take this practical way to see just what the book offers you. Mail the coupon today.

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Send me Wright's The Art of Conversation for 10 days' examination on approval. In 10 days I will send $2.50, plus few cents postage, or return book postpaid. (Postage paid on orders accompanied by remittance.)

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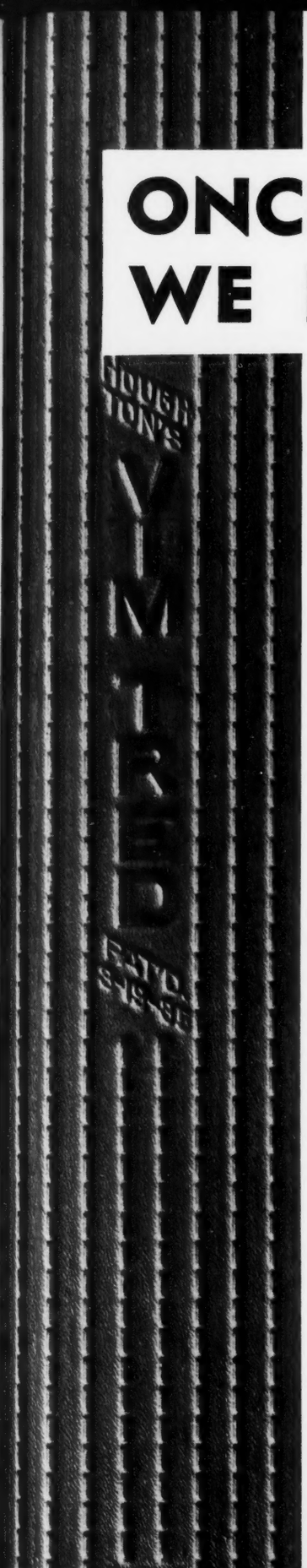


ONCE UPON A TIME WE LOST A BELT SALE . . .

and thereby proved our case!

An unusual story, this—the tale of a man who wouldn't buy a VIM Efficiency Drive* despite the soundest arguments for ultimate economy.

He insisted on a 3-ply 26″ belt with an idler, although it cost his firm $200 a year for maintenance of this 300-HP steam-belt-driven generator.

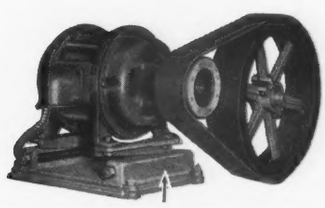
His former belts lasted only two years, and every breakdown brought a renewal of the Houghton Man's argument that the proper saving drive would be a pivoted base, short centers, and a VIM TRED Leather Belt.

We did prevail upon him to eliminate the idler. But with the cheaper belt he still required a replacement within two years.

Finally, after several vain tries at his own transmission design, he heeded our recommendation . . . installed a pivoted base, shortened the distance between centers, and put on a VIM TRED Leather Belt.

Less belt meant a saving in replacement, and VIM TRED meant a decided saving in maintenance. Thus far he hasn't spent a cent since he installed the new drive.

And what's more, he's getting greater voltage and amperage than with the former belt.



**The VIM Efficiency Drive consists of a pivoted motor base and a VIM TRED Leather Belt. Write for helpful data in "How to Belt Your Drives for More Profit".*

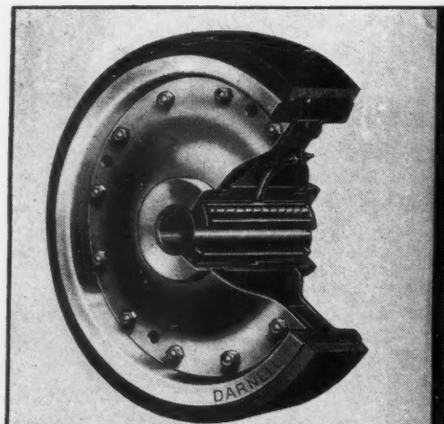
More power with less maintenance—that's the lesson more and more men are learning every day as VIM Efficiency drives, the best for short centers, increase steadily in plant popularity.

Add to this engineering service the powerful appeal of VIM TRED Leather Belt—its flexibility, long life, freedom from slippage,—and you have power transmission you'll boast about. Try it!

E. F. HOUGHTON & CO.

CHICAGO PHILADELPHIA DETROIT

VIM TRED
LEATHER BELTING



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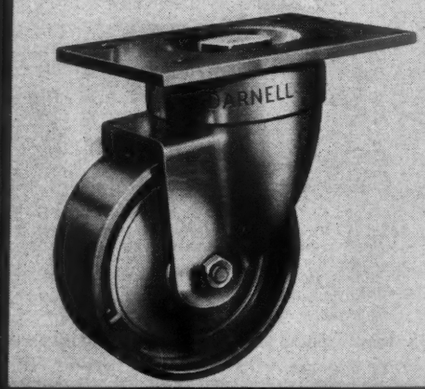
DARNELL CASTERS & WHEELS

. . . save Floors, lengthen life of equipment and increase the efficiency of your employees.



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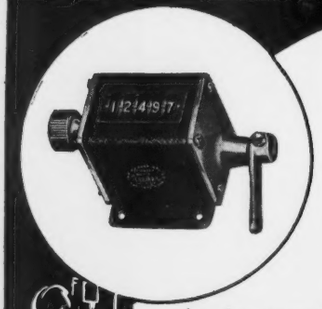

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On light drill and punch presses . . . and on duplicating, tabulating, check-writing and mailing machines . . . Veeder-Root Small Reset Counters are keeping accurate records, in terms of strokes or revolutions, that contribute to higher efficiency and lower costs.

Made in 3 types: ratchet counter (furnished with key reset, or thumb lever for traffic counting, if desired), revolution counter, and combined counter with reset register and non-reset totalizer. Speed of ratchet counters, 500 to 1000 counts per minute, depending on installation. Speed of revolution counter, 1000 rpm. 3, 4, or 5 figure wheels. Write for recommendations and prices.

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This old brick floor has been economically resurfaced with Hydro Proof yet it offers every feature of a costly new floor.

Rough and broken concrete, brick or stone floors retard production, cause accidents to employees and damage to materials being handled. They are noisy and distracting. When Hydro Proofed, they become smooth and even, tough and long wearing. Hydro Proof is waterproof, acid and fire resisting. Easily laid without special preparation of the floor.

5 gals. of Hydro Proof lays 45 square feet of ½" thick surface.

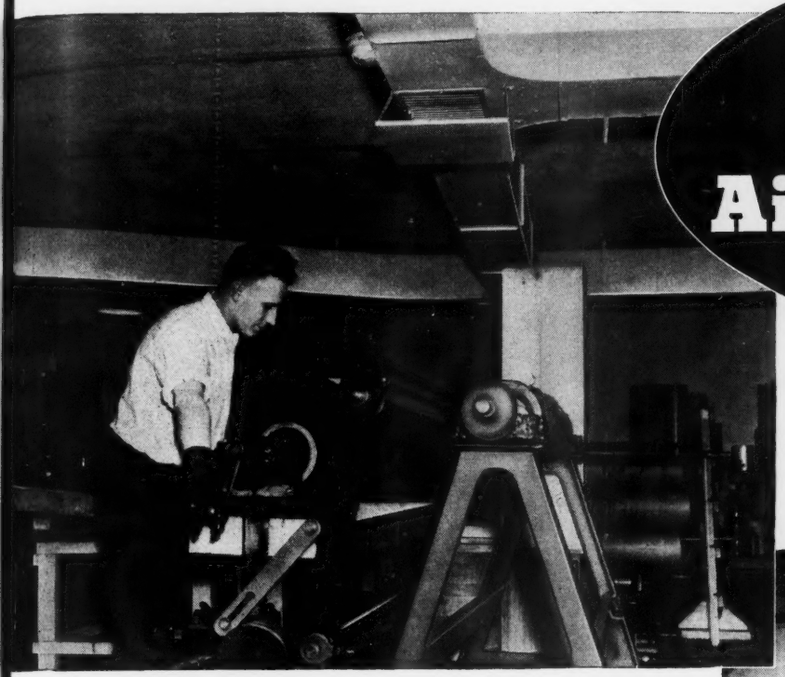
Order a trial drum today.

THE ASPHALT PRODUCTS CO.
INCORPORATED
SYRACUSE Eastwood Station NEW YORK

SIMPLICITY and ECONOMY

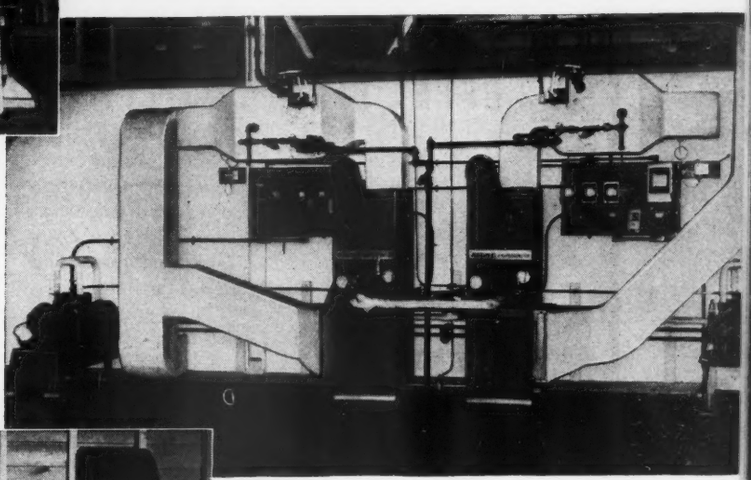
BIG FEATURES of Temperature and Humidity Control System

CORRECT HUMIDITY is essential the year around in the Garfield, N. J. plant of the Chambon Corporation. For, in addition to manufacturing high-speed printing presses for multi-color printing, this company prepares the printing plates themselves—and they've got to be exact! Here's how humidity and temperature too, are controlled with Carrier equipment—efficiently and at remarkably low cost.



Carrier
Air Conditioning

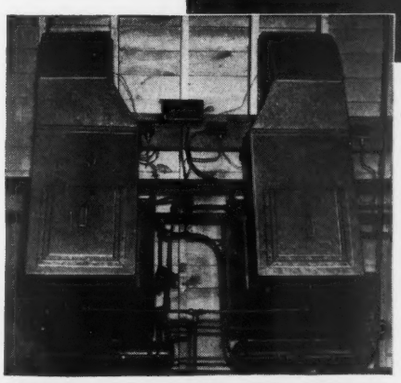
1. TWINS! Two Carrier Weathermakers, and two Carrier Refrigerating machines provide proper humidity and temperature conditions for one section of the plant—and do it without attention. As for water condensers—there are none. Instead . . .

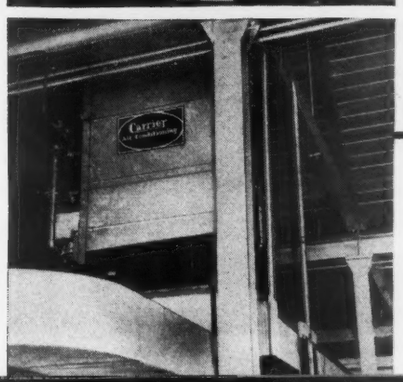


What is your Problem? Hardly any two manufacturers have exactly the same problems when it comes to air conditioning. Where one product requires an extremely low temperature, another requires just the opposite. The relative humidity that works wonders in one plant may be totally unsuitable for the plant across the street. Conditions are seldom *exactly* the same.

And that's why Carrier, and Carrier experience is invaluable. For more than 35 years, Carrier has devoted its efforts exclusively to the handling of air—to the design, the manufacture and the installation of air conditioning equipment. Carrier has met and solved problem after problem — constantly adding to its accumulative knowledge of "what to do" and "how to do it."

If your problem in any way concerns air conditioning, commercial refrigeration or space heating, by all means get the benefit of Carrier's experience. There's no obligation—why not call your nearest Carrier representative today?





2. MORE TWINS! Located under the gable of the roof are two small Carrier Evaporative Condensers, which use only 5% of the water required by water condensers—and require no water at all when the outdoor temperature is low. That means still greater savings, and eliminates the danger of freezing.

3. BIG BROTHER to the two small Carrier Evaporative Condensers is used in connection with another larger Carrier Weathermaker—the top of which is barely visible. And again the water consumption is reduced 95%—and accurate humidity and temperature control assured for the department it serves.

CARRIER CORPORATION, Desk 1108, Syracuse, N. Y.
Without obligation, send us the complete information on ☐ Carrier Air Conditioning; ☐ Carrier Air Conditioned Refrigeration; ☐ Carrier Space Heating.

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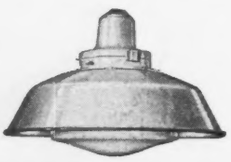
Company.....
Address.....
City.....

QUAD REFLECTORS

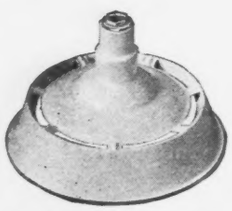
Give You The Safety and Efficiency of a Higher "SEE" Level

Higher intensity, even light distribution and no shadows are as requisite in the modern plant as the planned production schedules which Quad Reflectors help maintain all over the country.

HELPFUL DATA ON EFFECTIVE LIGHTING



QUAD Glassteel Diffuser. Easy Maintenance Safety Type—speeds up production and decreases spoilage.



QUAD Duplex Dome Reflector illuminates upper walls and ceilings with diffused light and delivers direct light downward.

New Quad pocket sized Data Book Catalog contains invaluable information on effective and economical lighting. Write for copy today. Gives recommended foot candle intensities, mounting and spacing data, also lamp size formulas and a lot of other new and helpful facts.

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YOUR FLOORS!

Look at your floors! There you see reflected a record of efficiency or waste—economy or extravagance—safety or hazard—sanitation or slovenliness. It is there for all others to see also.

If you want your floors to tell a story of money saved, labor costs reduced, of sanitation, cleanliness and beauty increased, then let us show you how Finnell machines and materials will help you. In these modern days, nothing less than electric scrubbing and waxing or polishing should be tolerated for *any* floor. There's a right Finnell for every type of floor maintenance . . . a right Finnell wax, filler, or soap, for every floor condition.

Service everywhere. *Demonstration Free!* Write or telephone the nearest Finnell office (see your phone book), or address FINNELL SYSTEM, INC., 2512 East Street, Elkhart, Indiana.

FINNELL

FLOOR MACHINES and FINISHERS

FOR LIQUID...GAS...STEAM

There's a Taylor Flow Meter to measure or control rate of flow with proved accuracy, efficiency, durability and economy in operation

Send for Special Taylor Catalog 70J—one of the most complete books on Flow (and Liquid Level) Instruments ever printed...

WHAT TYPE of instruments do you need for measuring or controlling rate of flow in your plant? Is it a comparatively simple matter of indicating or recording flow of a liquid... a gas... or steam? Is it a complex job of control?

No matter what your specific requirements are, you can make a selection of the correct instrument from the complete Taylor line. In these instruments you will find the modern refinements and improvements necessary to meet the severest demands in regulating continuous processes. You can be sure of the same accuracy, dependability, and economy that you obtain from Taylor Temperature and Pressure Instruments.

The many years of accurate, trouble-free service assured by Taylor Flow Meters help to make life easier and happier for a plant's management, its engineers and its foremen. The primary devices of these instruments are time-proved in principle and in actual operation. The secondary or measuring devices are standard Taylor Instruments with the outstanding features and advantages that have been known to major industries for a long, long time.

Taylor Flow Meters include the following:

DIAL TYPE INDICATORS . . . for liquids, or for gases or steam under constant pressure.

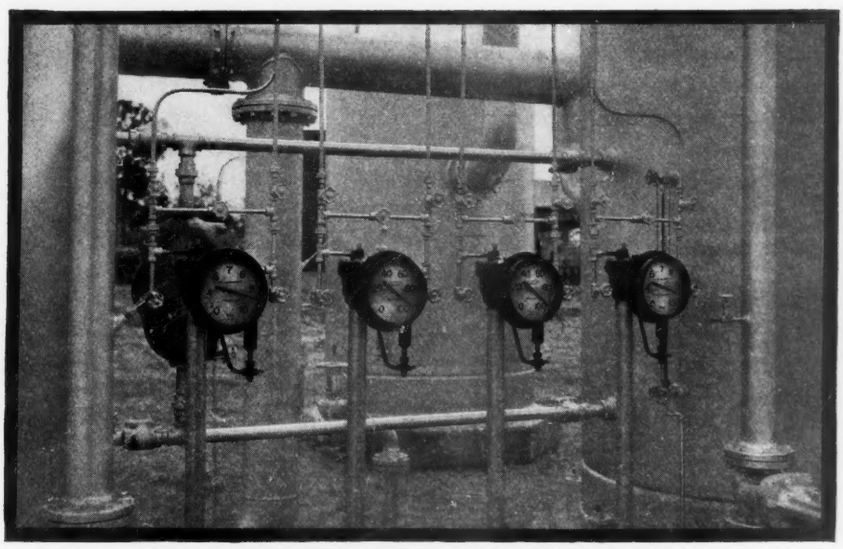
RECORDERS . . . single-pen types for liquids —two- and three-pen types for gases and steam.

INTEGRATING RECORDERS . . . for liquids —or for gases and steam.

CONTROLLERS . . . single-pen types for liquids—two- and three-pen types for gases and steam.

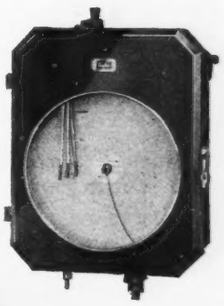
TIME-SCHEDULE CONTROLLERS; RE-SET CONTROLLERS; INDICATING FLOW CONTROLLERS and other types that you will see in Catalog 70J.

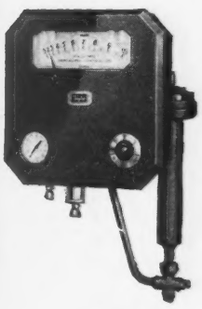
You really should have this Taylor Catalog 70J in your file. It is one of the most complete books on flow instruments ever put out by a manufacturer of instruments. (It tells about Taylor Liquid Level Instruments, too). It is so complete that in many cases you can select the instrument you need without any further inquiry. For this catalog and any help on control problems, ask a Taylor Representative, or write direct to Taylor Instrument Companies, Rochester, N. Y. Plant also in Toronto, Canada. Manufacturers in Great Britain—Short & Mason, Ltd., London, England.



Showing Taylor Flow Indicators which measure lean oil to, and gas flow from, absorbers in a Louisiana gasoline plant.

TAYLOR FLOW RECORDER. Single-pen type for liquids to record rate of flow directly, or differential pressure. Two-pen and three-pen types for gases and steam have graduated charts with scales for differential pressure and static pressure and/or temperature.





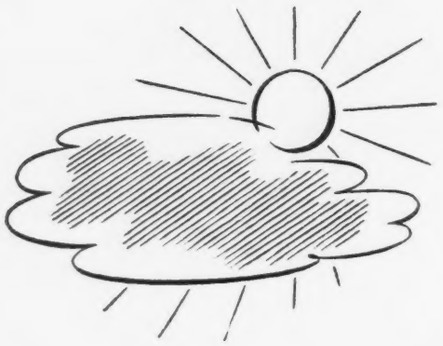
TAYLOR FULSCOPE INDICATING FLOW CONTROLLER for liquids . . . or for gases and steam under constant pressure. Flexible in design and completely adaptable to operating conditions and processing needs. For use in continuous processes where accurate throttling control is required.

Taylor

Indicating / Recording Controlling

TEMPERATURE, PRESSURE, FLOW —*and* LEVEL INSTRUMENTS

A GREAT NEW INDUSTRY GETS OFF ON THE RIGHT FOOT



THE air-conditioning industry has been a fertile field for misunderstandings and claims of unfair practice. Almost any device for humidifying a room or setting air in motion has at some time or other been labeled "air-conditioning." So many conflicting complaints had been presented to the National Better Business Bureau that it shouldered the job of organizing opinions and information from trade and scientific sources concerning the use of the term "air-contioning."

Architects, manufacturers, ventilating engineers and others collaborated and agreed in the view that *air-conditioning* does have a definite scientific meaning and cannot be used loosely in advertising. In November 1935, the Bureau's bulletin, defining the term and recommending minimum requirements, received wide publicity. Since then the Bureau has been successful in many cases in gaining the cooperation of appliance manufacturers concerning the observance of these recommendations.

Recently the air-conditioning industry has made use of the Bureau's definition, in conjunction with those of United States government departments, and beyond doubt the Bureau's initiative helped to stabilize the term *air-conditioning* for both trade and public.

• • •

This is the type of service the Bureau is uniquely equipped to perform in any specific field of business. Not always is it called in while an industry is still young. Not always is the issue as clean-cut as in this instance. But almost invariably the parties to a controversy in business ethics or unfair practice are afterwards glad they availed themselves of the Bureau's experience and background. The Bureau usually smooths matters out without publicity or prosecution. It is a non-profit organization and its services are available to members and non-members alike, but its support comes from members' contributions. Without obligation, write for Booklet "How to Use the National Better Business Bureau." Use coupon for your convenience.

NATIONAL BETTER BUSINESS BUREAU, INC.

405 Lexington Avenue, New York City

Please send me a copy of "How to Use the National Better Business Bureau."

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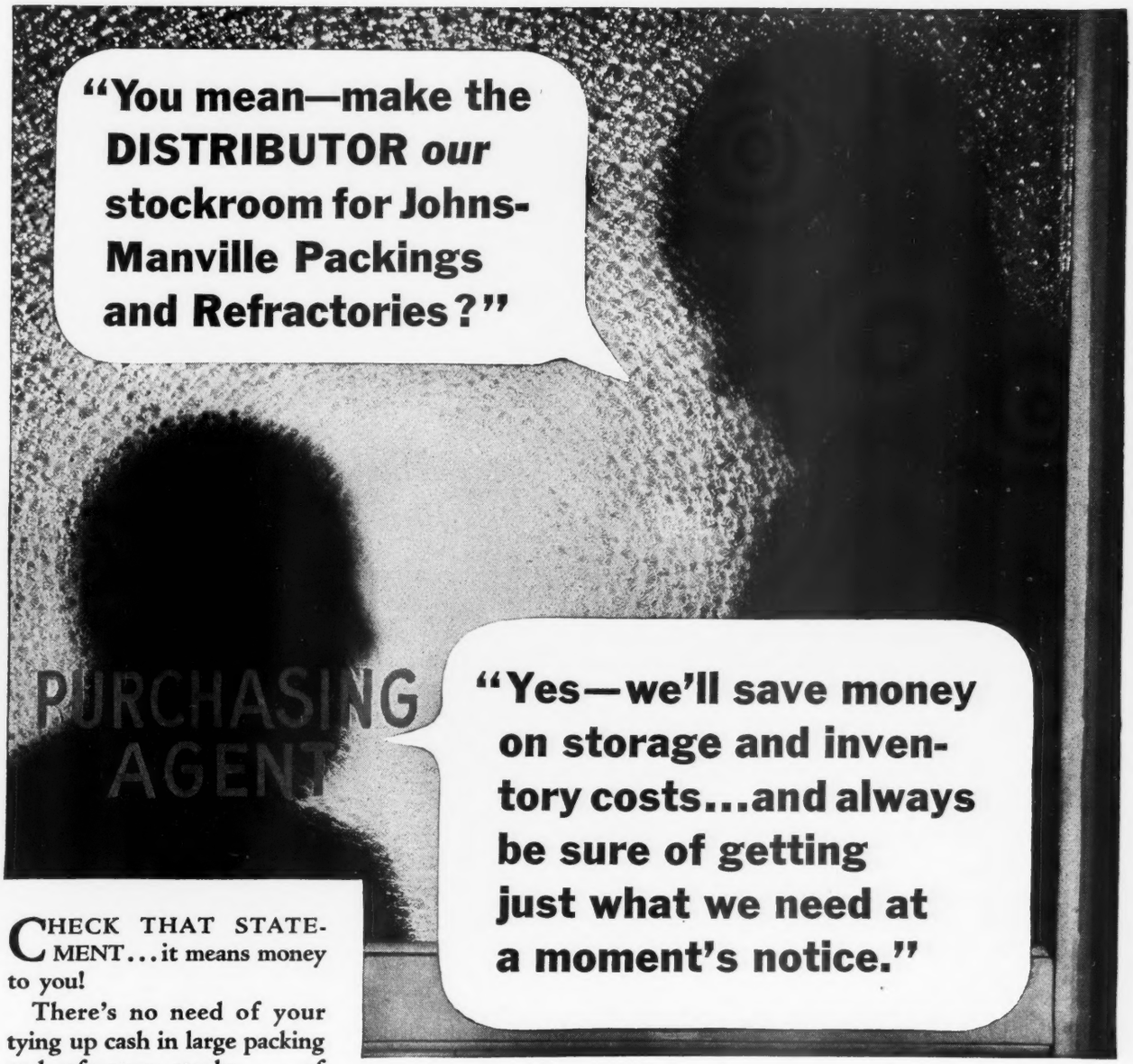
"You mean—make the DISTRIBUTOR *our* stockroom for Johns-Manville Packings and Refractories?"
PURCHASING AGENT
"Yes—we'll save money on storage and inventory costs...and always be sure of getting just what we need at a moment's notice."

CHECK THAT STATEMENT... it means money to you!

There's no need of your tying up cash in large packing and refractory stocks . . . of using up otherwise valuable storage space. And even when you do, the particular packing or refractory needed is often "among the missing" . . .

But consider this: A highly rated distributor, carrying J-M Packings and Refractories, can serve you *promptly* from a more complete stock than you could possibly want or profitably afford to carry.

And remember this, too. You can be sure of satisfaction with every J-M product you buy through J-M Distributors. Over 50 years spent in developing packings and refractories, and in servicing every industrial need, are behind these Johns-Manville products today. Their dependability, durability and economy are a matter of record.

For information on the characteristics and uses of J-M Packings and Refractories, and for the name of the nearest distributor, write to Johns-Manville, 22 E. 40th Street, New York City.

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INSULATIONS INDUSTRIAL FLOORING
FRICTION MATERIALS ROOFING & SIDING
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Advertise First in the Papers Men Have to Read!

It's the business papers' job to reach and inform the men who run American business and industry. The men who direct and manage! The men who design, operate and maintain! The men, in fact, who have anything and everything to say about the buying of equipment, material and supplies.

The most for your advertising dollar

Business papers waste no part of your advertising dollar on personal or family appeals. They are strictly business...all business...acting as regular consultants and accepted authorities on business problems. Men *have* to read them, to keep up.

Having no "dilution" of subscribers, a business paper list has more purchasing power, per reader, than any other form of media. It gives you first-hand contact with department heads and executives —the key men up and down the line. In a word, it achieves "penetration". Every business paper advertisement is, in effect, *an extra editorial.* An editorial on some important aspect of a man's business, about which he *must keep informed.* Tell your sales story to Industry's picked men—through business papers, the proven media for making sales!

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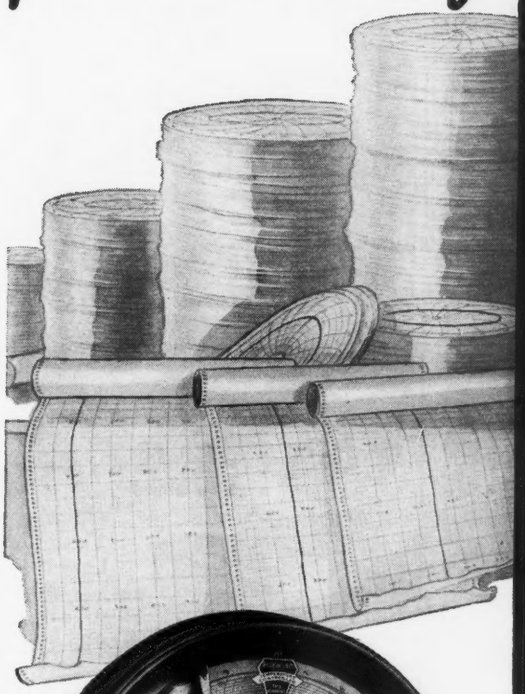
MILLIONS OF CHART RECORDS

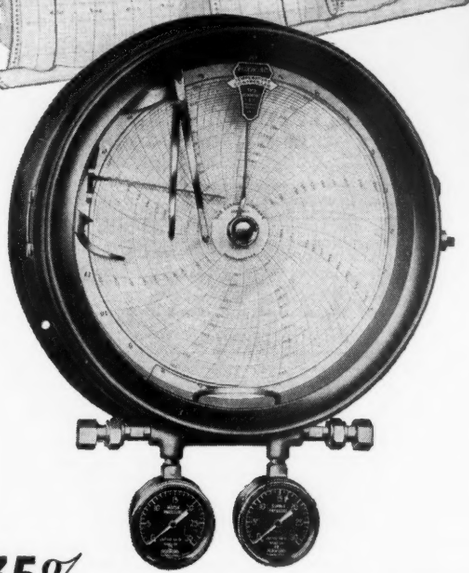
prove that for . . .

65%

of all temperature problems nothing will produce as good *control* as a simple

FOXBORO "Open and Shut" Controller





35% of control problems cannot be handled by "Open and Shut" Control. To satisfy specific problems involving varying amounts of throttling range Foxboro perfected the Stabilog Controller. It does a perfect job on the 35%. Each type of Foxboro Controller has its definite place. Foxboro engineers will gladly help you.

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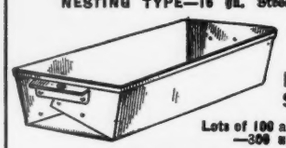

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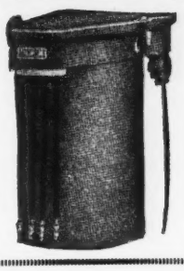

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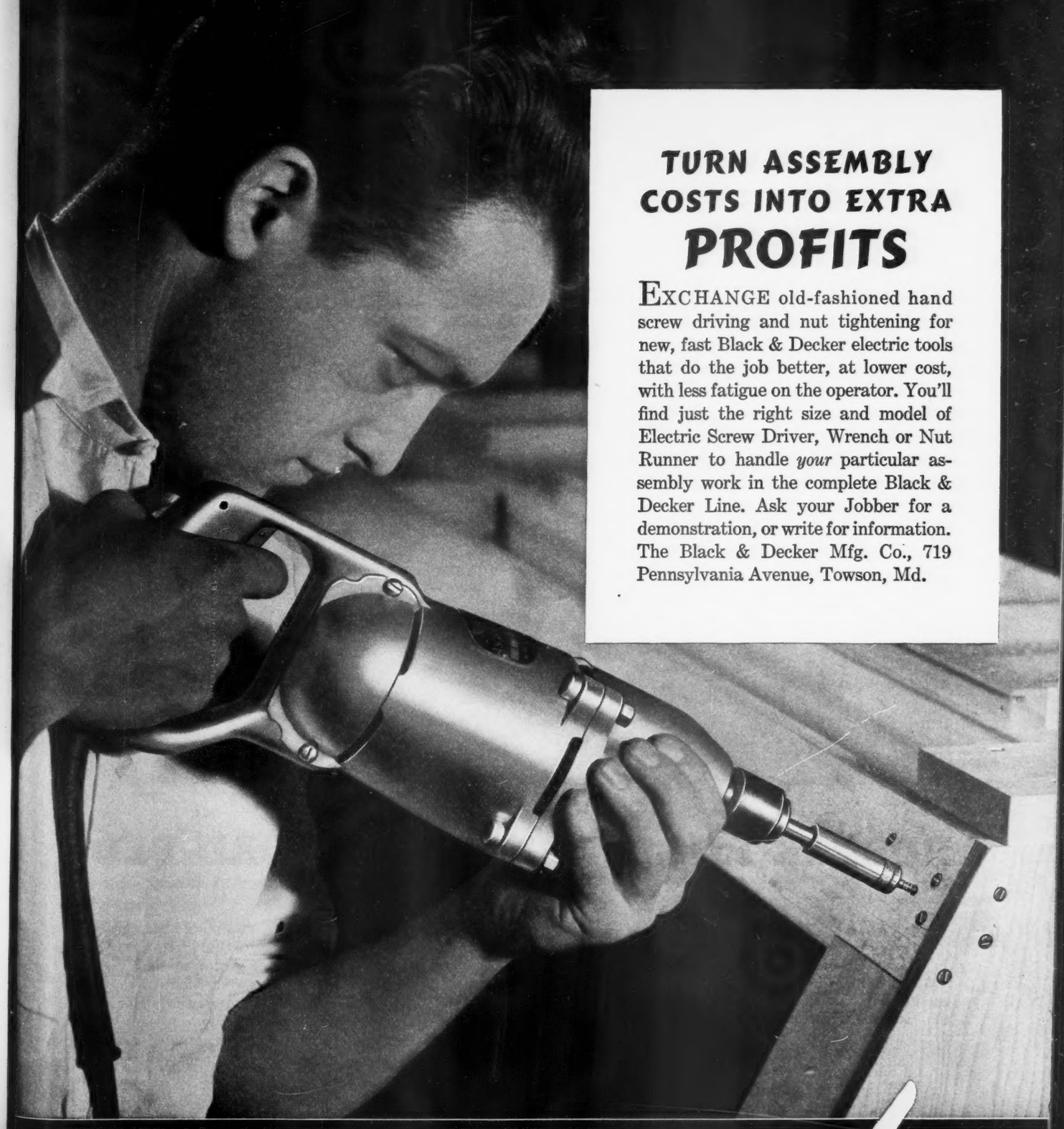

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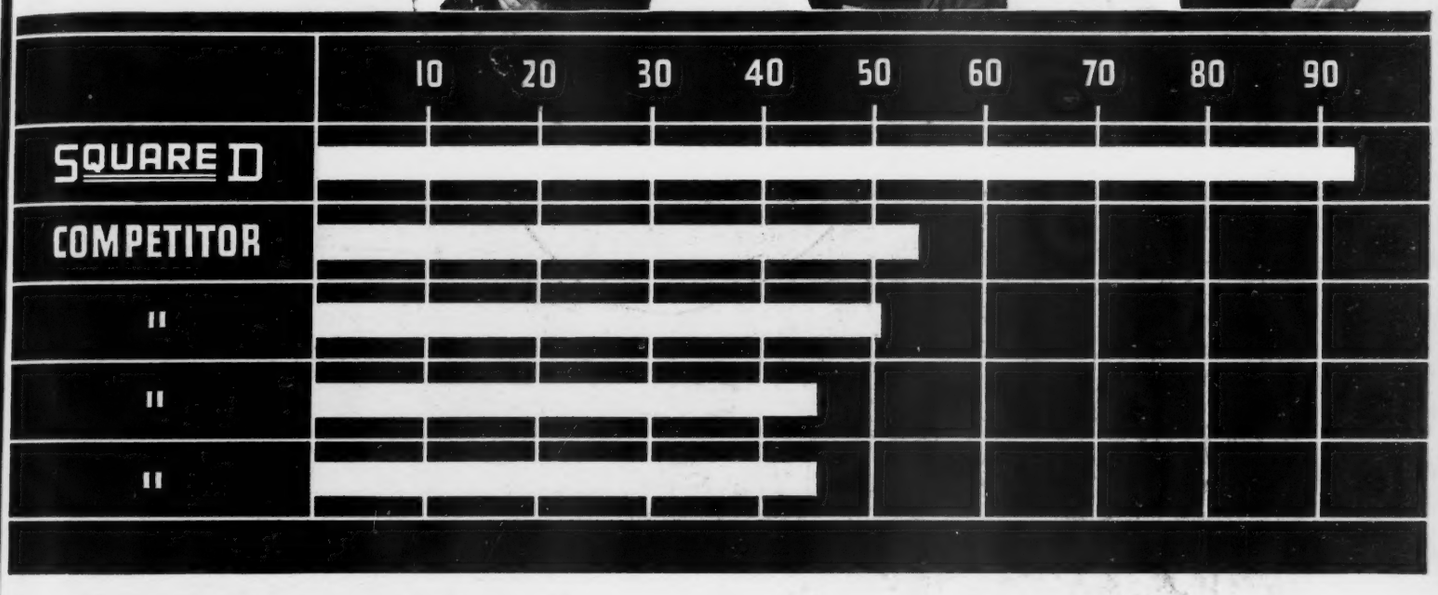
Goodrich was able to supply the rubber needed for this exacting use because of this Company's rubber research and development work. This research has resulted in many kinds of rubber with vastly improved resistance to ageing, and with ability to stand abrasion, flexing, chemicals which would have destroyed rubber as you used to know it. Many of these improvements are used in all Goodrich products—hose, transmission belting, conveyor belting, molded goods—to make them last longer and save money for the buyer. The B. F. Goodrich Company, Mechanical Rubber Goods Division, Akron, Ohio.

Goodrich

ALL *products problems* IN RUBBER

Another story of Goodrich development work appears on page three

These Three Men Voted on Six Features!...



SQUARE D scored 93%...

...SECOND CHOICE 54%

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SQUARE D COMPANY

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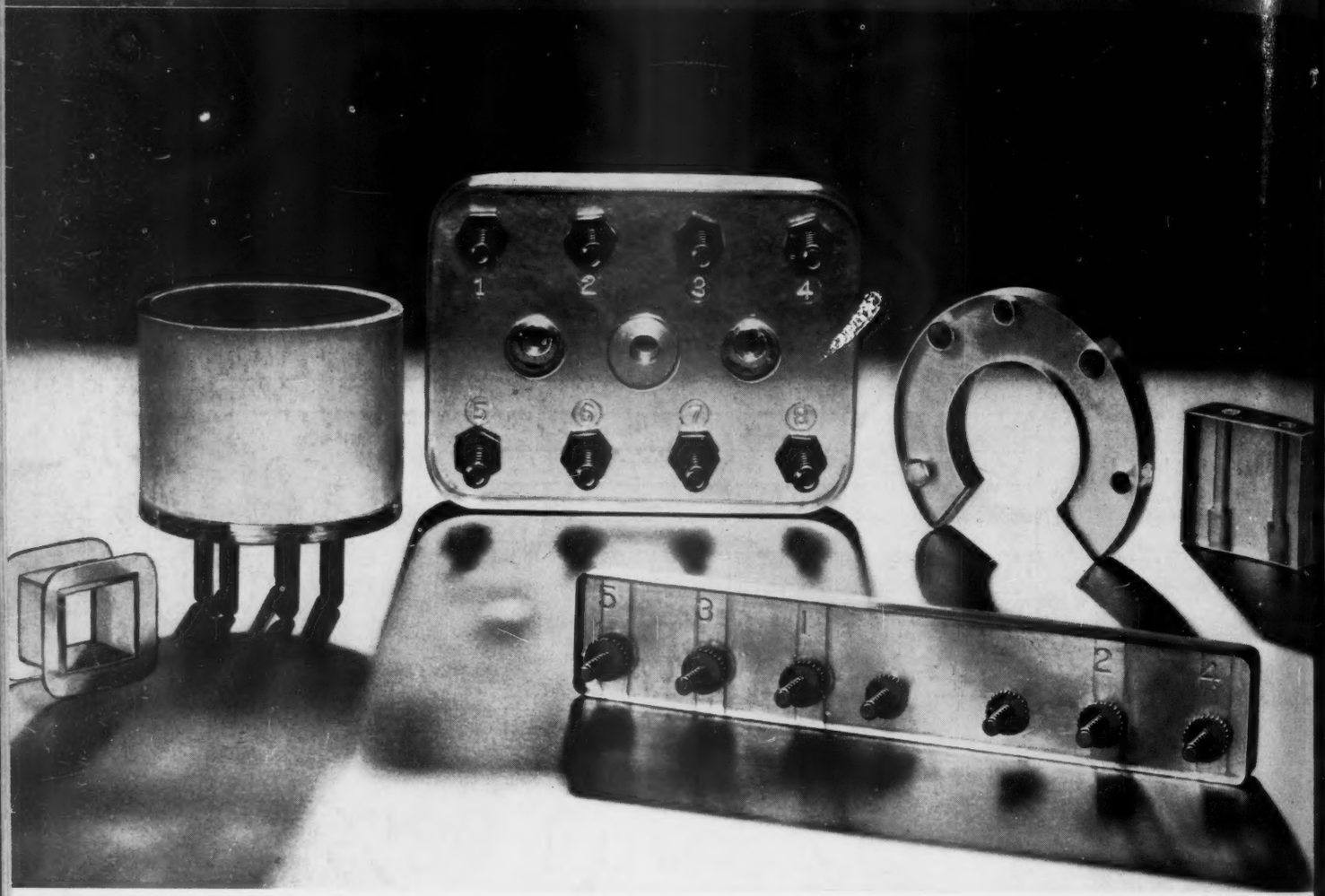

Advantageous applications of Bakelite XMS-10023 Material include: coil forms, tube bases, terminal blocks, spacing washers, connector blocks.

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Opportunities for the improvement of high-frequency apparatus through application of this new Bakelite molding material are practically unlimited. We invite electrical engineers and manufacturers to write for further data on Bakelite Polystyrene Low-Loss material.

BAKELITE CORPORATION, 247 PARK AVENUE, NEW YORK, N.Y.

BAKELITE CORPORATION OF CANADA, LIMITED, 163 Dufferin Street, Toronto, Canada *West Coast:* Electrical Specialty Co., Inc., 316 Eleventh Street, San Francisco, Cal.

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